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RCRA Facility Investigation – Remedial Investigation/ Corrective Measures Study – Feasibility Study (RI/FS) Report for the Rocky Flats Environmental Technology Site Appendix A – Comprehensive Risk Assessment

Volume 5 of 15
Risk Assessment for the Inter-Drainage Exposure Unit

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ACRONYMS AND ABBREVIATIONS

µg/kg	microgram per kilogram
µg/L	microgram per liter
AEU	Aquatic Exposure Unit
AI	adequate intake
BAF	bioaccumulation factor
bgs	below ground surface
BZ	Buffer Zone
CAD/ROD	Corrective Action Decision/Record of Decision
CD	compact disc
CDH	Colorado Department of Health
CDPHE	Colorado Department of Public Health and Environment
CMS	Corrective Measures Study
CNHP	Colorado Natural Heritage Program
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
DQA	data quality assessment
DQO	data quality objective
DRI	dietary reference intake
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EcoSSL	ecological soil screening level
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration

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ERA	Ecological Risk Assessment
ESL	ecological screening level
EU	Exposure Unit
HHRA	Human Health Risk Assessment
HQ	hazard quotient
HRR	Historical Release Report
IA	Industrial Area
IAEU	Industrial Area Exposure Unit
IAG	Interagency Agreement
IDEU	Inter-Drainage Exposure Unit
IHSS	Individual Hazardous Substance Site
kg	kilogram
LOAEL	lowest observed adverse effect level
LOEC	lowest effects concentration
MDC	maximum detected concentration
mg	milligram
mg/day	milligram per day
mg/kg	milligram per kilogram
mg/kg/BW/day	milligram per kilogram receptor body weight per day
mg/l	milligram per liter
mL	milliliter
mL/day	milliliter per day
N/A	not applicable or not available
NFA	No Further Action
NFAA	No Further Accelerated Action

NNEU	No Name Gulch Drainage Exposure Unit
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
OU	Operable Unit
PAC	Potential Area of Concern
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
pCi	picocurie
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PCOC	potential contaminant of concern
PMJM	Preble's meadow jumping mouse
PRG	preliminary remediation goal
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
RCEU	Rock Creek Drainage Exposure Unit
RCRA	Resource Conservation and Recovery Act
RDA	recommended daily allowance
RDI	recommended daily intake
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SCM	site conceptual model
tESL	threshold ESL

TRV	toxicity reference value
UBC	Under Building Contamination
UCL	upper confidence limit
UL	upper limit daily intake
UT	uncertain toxicity
UTL	upper tolerance limit
UWNEU	Upper Walnut Drainage Exposure Unit
UWOEU	Upper Woman Drainage Exposure Unit
VOC	volatile organic compound
WAEU	West Area Exposure Unit
WRS	Wilcoxon Rank Sum
WRV	wildlife refuge visitor
WRW	wildlife refuge worker
WSF	West Spray Field

EXECUTIVE SUMMARY

This report presents the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the 596-acre Inter-Drainage Exposure Unit (EU) (IDEU) at the Rocky Flats Environmental Technology Site (RFETS). The purpose of this report is to assess potential risks to human health and ecological receptors posed by exposure to contaminants of concern (COCs) and ecological contaminants of potential concern (ECOPCs) remaining at the IDEU after completion of accelerated actions at RFETS.

Results of the COC selection process for the HHRA indicate that no COCs were selected and there are no significant human health risks from RFETS-related operations at the IDEU. As a result, potential health risks for the wildlife refuge worker (WRW) and wildlife refuge visitor (WRV) are expected to be within the range of background risks. The estimated cancer risks for the WRW and WRV associated with potential exposure to background levels of naturally occurring metals in surface soil/surface sediment are both approximately 2E-06. The estimated noncancer hazard indices associated with potential exposure to background levels of metals in surface soil/surface sediment are approximately 0.3 for the WRW and 0.1 for the WRV.

In the ERA, ECOPCs in surface soil were identified for non-Preble's meadow jumping mouse (PMJM) receptors only. ECOPCs for selected populations of non-PMJM receptors included antimony and lead. No ECOPCs were identified in subsurface soil. The ECOPC/receptor pairs were evaluated in the risk characterization using a range of EPCs, exposure scenarios, and toxicity reference values to give a range of risk estimates. Overall, risks were classified as low for all non-PMJM ECOPC/receptor pairs.

The high species diversity and continued use of the site by numerous vertebrate species verify that habitat quality for these species remains acceptable and that the ecosystem functions are being maintained. Data collected on wildlife abundance and diversity indicate that wildlife populations are stable and that species richness remains high during remediation activities at RFETS, including wildlife using the IDEU. Overall, no significant risk to survival, growth, and reproduction is predicted for the ecological receptors evaluated in the IDEU.

1.0 INTER-DRAINAGE EXPOSURE UNIT

This volume of the Comprehensive Risk Assessment (CRA) presents the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the Inter-Drainage Exposure Unit (EU) (IDEU) at the Rocky Flats Environmental Technology Site (RFETS) (Figure 1.1).

The HHRA and ERA methods and selection of receptors are described in detail in the Final CRA Work Plan and Methodology (DOE 2005a), hereafter referred to as the CRA Methodology. The HHRA and ERA methods and selection of receptors are described in detail in the approved CRA Methodology. A summary of the risk assessment methods, including updates made in consultation with the regulatory agencies, are summarized in Appendix A, Volume 2, Section 2.0 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report). The anticipated future land use of RFETS is a wildlife refuge. Two human receptors, a wildlife refuge worker (WRW) and a wildlife refuge visitor (WRV), are evaluated in this risk assessment consistent with this land use. A variety of representative terrestrial and aquatic receptors are evaluated in the ERA including the Preble's meadow jumping mouse (PMJM), a federally listed threatened species present at the RFETS.

1.1 Inter-Drainage Exposure Unit Description

This section provides a brief description of the IDEU, including its location at RFETS, historical activities in the area, topography, surface water features, vegetation, and ecological resources. A more detailed description of these features and additional information regarding the geology, hydrology, and soil types at RFETS is included in Section 2.0, Physical Characteristics of the Study Area, of the RI/FS Report.

The 2005 Annual update to the Historical Release Report (HRR) (DOE 2005b) and its annual updates provide descriptions of known or suspected releases of hazardous substances that occurred at RFETS. The original HRR (DOE 1992a) organized these known or suspected historical sources of contamination as Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern (PACs), or Under Building Contamination (UBC) areas (hereafter collectively referred to as historical IHSSs). Individual historical IHSSs and groups of historical IHSSs were also designated as Operable Units (OUs). Over the course of cleanup under the 1991 Interagency Agreement (IAG) and the 1996 Rocky Flats Cleanup Agreement (RFCA), the U.S. Department of Energy (DOE) has thoroughly investigated and characterized contamination associated with these historical IHSSs. Historical IHSSs have been dispositioned through appropriate remedial actions or by determining that No Further Accelerated Action (NFAA) is required, pursuant to the applicable IAG and RFCA requirements. Some OUs have also been dispositioned in accordance with an OU-specific Corrective Action Decision/Record of Decision (CAD/ROD).

A more detailed description of the regulatory agreements and the investigation and cleanup history under these agreements is contained in Section 1.0 of the RI/FS Report. Section 1.4.3 of the RI/FS Report describes the accelerated action process, and the disposition of all historic IHSSs at RFETS is summarized in Table 1.4 of the RI/FS Report. In the 2005 Annual Update to the HRR (DOE 2005b) each historical IHSS is provided a description of the potential contaminant releases and any interim response to the releases; identifications of potential contaminants based on process knowledge, and site data; data collection activities; accelerated action activities (if any); and the basis for recommending no further accelerated action.

Two IHSSs and two PACs exist within the IDEU (Figure 1.2): the West Spray Field (WSF) (IHSS 168), the Nickel Carbonyl Disposal Area (IHSS 195), roadway spray areas (PAC-000-501), and the tear gas powder release (PAC NE-1400). These documented historical source areas are described in Table 1.1. IHSS 168 was also designated as OU 11. OU 11 was dispositioned through a no further action (NFA)CAD/ROD, approved in October 1995 (Administrative Record reference OU11-A-000184). A Risk Evaluation performed for the Final "No Further Action Justification" document (DOE 1992b) determined that IHSS 195 presented no unacceptable risk to groundwater or human health and the environment. IHSS 195 was dispositioned in the August 1994 CAD/ROD for OU 16, Low Priority Sites. The two PACs were found to require NFA as documented in the 2002 HRR Update (DOE 2002).

1.1.1 Exposure Unit Characteristics and Location

The 596-acre IDEU is located in the northwestern portion of RFETS (Figure 1.1) and contains several distinguishing features:

- The IDEU is located within the Buffer Zone (BZ) OU and is outside the Industrial Area (IA) that was used historically for manufacturing and processing operations at RFETS;
- The IDEU is located generally upwind and hydraulically upgradient of the IA; and
- The IDEU is a functionally distinct exposure area. It is a level terrace of the Rocky Flats plain, lying between two stream-cut valleys (Rock Creek and Walnut Creek), with sparse vegetation and a relative scarcity of water and wetland habitat.

The IDEU is bounded by the West Area EU (WAEU) to the west; the Rock Creek Drainage EU (RCEU) to the northwest; and the No Name Gulch Drainage EU (NNEU), Upper Walnut Drainage EU (UWNEU), and Industrial Area EU (IAEU) to the southeast (Figure 1.1). Land south of the IDEU consists of the Upper Woman Drainage EU (UWOEU) and privately owned land.

1.1.2 Topography and Surface Water Hydrology

The IDEU gently slopes from the southwest to the northeast, straddling the Rock Creek and Walnut Creek drainage basins. The IDEU includes the main portions of Upper Church Ditch and McKay Ditch, as well as portions of the McKay Bypass Canal (Figure 1.2).

Upper Church Ditch is a seldom used, although still active, water conveyance structure that diverts water from Coal Creek to Upper Church Lake and the Great Western Reservoir. The City of Broomfield owns and operates this ditch. Upper Church Ditch runs along the length of the IDEU and parallels McKay Ditch on the upslope side.

McKay Ditch diverts water for irrigation from the South Boulder Diversion Canal to the Great Western Reservoir. The City of Broomfield owns and operates this ditch. The McKay Ditch is generally dry, except in the spring. Originally, the McKay Ditch flowed into North Walnut Creek. In September 1974, the West Diversion Ditch and McKay Bypass Canal were constructed to route the McKay Ditch flow north of the Present Landfill. Water in the upper reaches of the North Walnut Creek watershed (west of the IA) is intercepted and diverted by the West Diversion Ditch, which also discharges into the McKay Bypass Canal. The McKay Bypass Canal runs eastward paralleling the Upper Church Ditch and McKay Ditch for about 8,000 feet.

A small man-made pond is located in the southern portion of the IDEU. The pond has been used for raw water storage prior to treatment and distribution for drinking water at RFETS. The pond is referred to as the Raw Water Pond, or 124 Pond, because it was connected by a pipeline to the drinking water treatment plant (Building 124). A water source no longer exists for the pond, and it is anticipated that it will become dry.

Two prominent surface disturbance features and a pond are visible on an October 2004 aerial photograph (Figure 1.3). The disturbed area located in the southwestern portion of the IDEU is associated with gravel-mining activities. The second area in the central portion of the IDEU was excavated to accommodate a landfill, but was never used as a landfill (that is, no waste disposal activities took place). It is currently used as a staging area for site activities.

1.1.3 Flora and Fauna

The IDEU is characterized predominantly by xeric tallgrass prairie (Figure 1.4). Small areas of wetland and mesic mixed grassland exist in and adjacent to the drainages. An area of xeric needle and thread grass prairie exists in the northern portion of the IDEU. The xeric tallgrass prairie is distinguished at RFETS by such plant species as big bluestem (*Andropogon gerardii*), little bluestem (*Andropogon scoparius*), Indian-grass (*Sorghastrum nutans*), prairie dropseed (*Sporobolus heterolepis*), and switchgrass (*Panicum virgatum*); the same species that dominate the plant community on the eastern edge of the Great Plains.

Land that is within the IDEU was heavily grazed during the past land use. With the purchase by the DOE, grazing has not occurred in decades within the EU, and plant

communities have nearly returned to pre-grazing conditions. The Colorado Natural Heritage Program (CNHP) classifies the xeric tallgrass prairie plant community as very rare (CNHP 1995). Portions of this plant community in the IDEU, along with other areas within RFETS and the surrounding lands, comprise one of the largest remnants of xeric tallgrass prairie.

The IDEU contains two plant species recognized by CNHP as rare or imperiled. They are the mountain-loving sedge (*Carex oreocharis*) and the forktip three-awn (*Aristada basiramea*) (K-H 2002). The mountain-loving sedge grows in dry grasslands and prefers locations off the edge of the pediment on north-facing slopes. This plant occurs along the northwestern edge of the IDEU. Forktip three-awn occurs within the xeric tallgrass prairie in areas that have been disturbed and the vegetation has been removed. There are few locations where forktip three-awn are known to exist in Colorado and RFETS has several sites (K-H 2002).

Numerous animal species have been observed at RFETS, and the more common ones are expected to be present in the IDEU. Common large- and medium-sized mammals likely to live at or frequent the IDEU include deer (*Odocoileus hemionus*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), desert cottontail (*Sylvilagus audubonii*), and white-tailed jackrabbit (*Lepus townsendii*). The most common reptile observed at RFETS is the western prairie rattlesnake (*Crotalis viridus*), and the most common birds include meadow lark (*Sturnella neglecta*), vesper sparrow (*Pooecetes gramineus*) and mourning dove (*Zenaida macroura*). The most common small mammal species include deer mouse (*Peromyscus maniculatus*) and prairie vole (*Microtus ochrogaster*). Xeric grasslands also support two different species of pocket mouse (*Perognathus sp.*) (DOE 1995).

More information on the species that use the habitats at RFETS is provided in Section 2.0 of the RI/FS Report.

1.1.4 Preble's Meadow Jumping Mouse Habitat within Inter-Drainage Exposure Unit

The PMJM is a federally listed threatened species found at RFETS. The preferred habitat for the PMJM is the riparian corridors bordering streams, ponds, and wetlands at RFETS with an adjacent thin band of upland grasslands. PMJM habitat occurs along the upper reach of North Walnut Creek in the southwestern portion of the IDEU and along the northwest edge of the EU bordering the Rock Creek drainage (Figure 1.5). No PMJM have ever been captured in the IDEU. The lack of continuously running water along the McKay Ditch is likely a limiting factor to PMJM abundance.

In an effort to characterize habitat discontinuity and provide indications of varying habitat quality, sitewide PMJM habitat patches were developed. Figure 1.5 presents PMJM patches within the IDEU. Patches that cross-over into the Rock Creek Drainage and the Upper Walnut Drainage EUs are considered within those EUs as appropriate. PMJM patches aid in the evaluation of surface soil within PMJM habitat, giving a spatial understanding of areas that may be used by individual PMJM or subpopulations of PMJM. More detail on the methodology of creating sitewide PMJM habitat patches can be found in Appendix A, Volume 2, Section 3.2 of the RI/FS Report.

After recognizing patches that cross-over into other EUs, only two PMJM habitat patches within the IDEU were evaluated in this volume. The following is a brief discussion of the two patches within the IDEU (Figure 1.5):

- Patch #9 – This patch contains short marsh and small areas of riparian shrublands intermixed with snowberry, which is an upland shrub. This patch is mapped as protected habitat (FWS 2004) due to the presence of woody riparian vegetation along the upper reaches of North Walnut Creek (Figure 1.4). This area contains the vegetative components necessary for PMJM habitat, but typically lacks water. The patch only receives water during storm events and when the ditch is conveying water. The habitat quality of this patch is very low and no PMJM have ever been observed in or near this area on RFETS.

- Patch #31- This patch begins along the border with the West Area EU and continues east along the McKay Ditch to the confluence with the McKay Ditch Bypass Canal. This patch is mapped as protected habitat (FWS 2004) due to the presence of riparian woodlands along the McKay Ditch (Figure 1.4). This area contains the vegetative components necessary for PMJM habitat, but typically lacks water. The patch only receives water during storm events and when the ditch is conveying water. The habitat quality of this patch is very low and no PMJM have ever been observed in or near this area on RFETS.

1.1.5 Data Description

Data have been collected at RFETS under regulatory agency-approved Work Plans, Sampling and Analysis Plans (SAPs), and Quality Assurance Project Plans (QAPjPs) to meet data quality objectives (DQOs) and appropriate U.S. Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE) guidance. Surface soil, subsurface soil, surface sediment, subsurface sediment, and groundwater samples were collected from the IDEU. Surface soil/surface sediment, subsurface soil/subsurface sediment, surface soil, and subsurface soil are the media evaluated in the HHRA and ERA (Table 1.2). The sampling locations for these media are shown on Figures 1.6 and 1.7, and data summaries for detected analytes in each medium are provided in Tables 1.3 through 1.7. Potential contaminants of concern (PCOCs) and ecological contaminants of interest (ECOIs) that were analyzed for but not detected, or were detected in less than 5 percent of the samples, are presented in Attachment 1. Detection limits are compared to preliminary remediation goals (PRGs) and ecological screening levels (ESLs) and discussed in Attachment 1 (Tables A1.1 through A1.4). Only data from June 1991 to the present are used in the CRA because these data meet the approved analytical Quality Assurance/Quality Control (QA/QC) requirements.

In accordance with the CRA Methodology, only data collected on or after June 28, 1991, and data for subsurface soil and subsurface sediment samples with a start depth less than or equal to 8 feet below ground surface (bgs) are used in the CRA. Subsurface soil and subsurface sediment data are limited to this depth because it is not anticipated that the WRW or burrowing animals will dig to deeper depths. A detailed description of data storage and processing methods is provided in Appendix A, Volume 2 of the RI/FS

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Report. The CRA analytical data set for the IDEU is provided on a compact disc (CD) presented in Attachment 6. The CD includes the data used in the CRA as well as data not considered useable based on criteria presented in Appendix A, Volume 2 of the RI/FS Report.

The sampling data used for the IDEU HHRA and ERA are as follows:

- Combined surface soil/surface sediment data (HHRA);
- Combined subsurface soil/subsurface sediment data (HHRA);
- Surface soil data (ERA); and,
- Subsurface soil data (ERA).

The data for these media are briefly described below.

In addition, because ECOPCs were identified for soil in this EU, surface water data were used in the ERA as part of the overall intake of ecological contaminants of potential concern (ECOPCs) by ecological receptor. The surface water data used in the ERA are summarized in Table 8.5. Surface water and sediment are assessed for ecological receptors on an Aquatic Exposure Unit (AEU) basis in Appendix A, Volume 15 of the RI/FS Report. An assessment of the surface water, groundwater-to-surface water, and volatilization pathways for human health are presented in Appendix A, Volume 2 of the RI/FS Report.

Surface Soil/Surface Sediment

The combined surface soil/surface sediment data set for the IDEU consists of up to 83 samples that were analyzed for inorganics (64 samples), organics (three samples), and radionuclides (83 samples) (Table 1.2). The data include sediment samples collected to depths down to 0.5 feet bgs. The sampling locations for surface soil and surface sediment are shown on Figure 1.6. Surface soil/surface sediment samples were collected in the IDEU for several months from November 1992 through September 1994 and then again in February 2004 and March 2004. The samples collected in 2004 were located on a 30-acre grid, as described in CRA SAP Addendum #04-01 (DOE 2004). For the grid sampling, five individual samples were collected from each 30-acre cell, one from each quadrant and one from the center, as described in the Addendum (DOE 2004). Most of the evenly spaced surface soil sampling locations on Figure 1.6 represent the 30-acre grid samples.

The data summary for detected analytes in surface soil/surface sediment for the IDEU is presented in Table 1.3. Detected analytes include representatives from the inorganics and radionuclides analyte groups. A summary of analytes that were either not detected in, or detected in less than 5 percent of, surface soil/surface sediment sample in the IDEU is presented and discussed in Attachment 1.

Subsurface Soil/Subsurface Sediment

Subsurface soil samples used in the CRA are defined in the CRA Methodology as soil samples with a starting depth less than or equal to 8 feet bgs and an ending depth below 0.5 feet. Subsurface sediment samples (sediment samples with a start depth less than or equal to 8 feet bgs and an end depth below 0.5 feet) were not collected in the IDEU. The combined subsurface soil/subsurface sediment data set for the IDEU consists of up to 72 samples that were analyzed for inorganics (72 samples), organics (65 samples), and radionuclides (70 samples) (Table 1.2). The sampling locations for subsurface soil are shown in Figure 1.7. Subsurface soil samples were collected in the IDEU for several months from February 1992 through August 1994 and then again in February 2004.

The data summary for detected analytes in subsurface soil/subsurface sediment for the IDEU is presented in Table 1.4. Detected analytes include representatives from the inorganics, organics, and radionuclides analyte groups. A summary of analytes that were either not detected in, or detected in less than 5 percent of, subsurface soil/subsurface sediment sample in the IDEU is presented and discussed in Attachment 1.

Surface Soil

Data meeting the CRA requirements are available for up to 81 surface soil samples collected in the IDEU that were analyzed for inorganics (64 samples), organics (three samples), and radionuclides (81 samples) (Table 1.2). The surface soil sampling locations for the IDEU are shown in Figure 1.6. Surface soil samples were collected in the IDEU for several months from November 1992 through September 1994 and then again in February 2004 and March 2004. The samples collected in 2004 were located on a 30-acre grid, as described in CRA SAP Addendum #04-01 (DOE 2004). For the grid sampling, five individual samples were collected from each 30-acre cell, one from each quadrant and one from the center, as described in the Addendum (DOE 2004). Most of the evenly spaced surface soil sampling locations in Figure 1.6 represent the 30-acre grid samples.

The data summary for detected analytes in IDEU surface soil is presented in Table 1.5, while the data summary for the detected analytes for those samples within designated PMJM habitat is presented in Table 1.6. As discussed in Appendix A, Volume 2 of the RI/FS Report, those samples within 100 feet of PMJM habitat patch # 3.1 were used as the PMJM data set for the IDEU. Radionuclides and inorganics were detected in IDEU surface soil samples. A summary of analytes that were either not detected in, or detected in less than 5 percent of, surface soil sample in the IDEU is presented and discussed in Attachment 1.

Subsurface Soil

Subsurface soil samples used in the CRA are defined in the CRA Methodology as soil samples with a starting depth less than or equal to 8 feet bgs and an ending depth below 0.5 feet. The subsurface soil data set for the IDEU consists of up to 72 samples that were analyzed for organics (65 samples), inorganics (72 samples), and radionuclides (70 samples) (Table 1.2). Subsurface soil sampling locations are shown in Figure 1.7. Subsurface soil samples were collected in the IDEU for several months from February 1992 through August 1994 and then again in February 2004.

The data summary for detected analytes in subsurface soil for the IDEU is presented in Table 1.6. Subsurface soil samples were analyzed for inorganics, organics, and radionuclides, and representatives from all three analyte groups were detected. A summary of analytes that were either not detected, or detected in less than 5 percent of, in subsurface soil sample in the IDEU is presented and discussed in Attachment 1.

1.2 Data Adequacy Assessment

A data adequacy assessment was performed to determine whether the available data set discussed in the previous section is adequate for risk assessment purposes. The data adequacy assessment rules are presented in the CRA Methodology, and a detailed data adequacy assessment for the data used in the CRA is presented in Appendix A, Volume 2 of the RI/FS Report. The adequacy of the data was assessed by examining the number of available samples for each analyte group in each medium for use in the CRA, the spatial and temporal representativeness of the data, as well as information on potential historical sources of contamination, migration pathways, and the concentration levels in the media. The assessment concludes that the data are adequate for the purposes of the CRA.

1.3 Data Quality Assessment

A data quality assessment (DQA) of the IDEU data was conducted to determine whether the data were of sufficient quality for risk assessment use. The DQA is presented in Attachment 2, and an evaluation of the entire RFETS data set is presented in Appendix A, Volume 2 of the RI/FS Report. The quality of the laboratory results were evaluated for compliance with the CRA Methodology DQOs through an overall review of precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. This review concluded that the data are of sufficient quality for use in the CRA, and the CRA DQOs have been met.

2.0 SELECTION OF HUMAN HEALTH CONTAMINANTS OF CONCERN

The human health contaminant of concern (COC) screening process is described in Section 4.4 of the CRA Methodology (DOE 2004a) and summarized in Appendix A, Volume 2 of the RI/FS Report (Section 2.2).

The human health COC selection process was conducted for surface soil/surface sediment and subsurface soil/subsurface sediment in the IDEU. Results of the COC selection process are summarized below.

2.1 Contaminant of Concern Selection for Surface Soil/Surface Sediment

Detected PCOCs in surface soil/surface sediment samples (Table 1.3) are screened in accordance with the CRA Methodology to identify the COCs.

2.1.1 Surface Soil/Surface Sediment Cation/Anion and Essential Nutrient Screen

The major cations and anions that do not have toxicity criteria are eliminated from assessments in surface soil/surface sediment in accordance with the CRA Methodology.

The essential nutrient screen for analytes detected in surface soil/surface sediment is presented in Table 2.1. The screen includes PCOCs that are essential for human health and do not have toxicity criteria available. Table 2.1 shows the maximum detected concentrations (MDCs) for essential nutrients, daily intake estimates based on the MDCs, and dietary reference intakes (DRIs). The DRIs are identified in the table as recommended daily allowances (RDAs), recommended daily intakes (RDIs), adequate intakes (AIs), and upper limit daily intakes (ULs). The estimated daily maximum intakes based on the nutrients' MDCs and a surface soil/surface sediment ingestion rate of 100 milligrams per day (mg/day) are less than the DRIs. Therefore, these PCOCs were not further evaluated as COCs for surface soil/surface sediment.

2.1.2 Surface Soil/Surface Sediment Preliminary Remediation Goals Screen

Table 2.2 compares the MDCs and upper confidence limits (UCLs) to the WRW PRGs for each PCOC. If the MDC and the UCL are greater than the PRG, the PCOC is retained for further screening; otherwise, it not further evaluated. Arsenic was the only analyte in surface soil/surface sediment that had an MDC and UCL that exceeded the PRG and was retained as a PCOC.

PRGs were not available for several PCOCs in surface soil/surface sediment. Analytes without PRGs are listed on Table 2.2 and their effect on the conclusions of the risk assessment results is discussed in the uncertainty section (Section 6.0).

2.1.3 Surface Soil/Surface Sediment Detection Frequency Screen

Arsenic was detected in more than 5 percent of surface soil/surface sediment samples and was therefore retained for further evaluation in the COC screen (Table 1.3).

2.1.4 Surface Soil/Surface Sediment Background Analysis

Results of the background statistical comparison for arsenic is presented in Table 2.3 and discussed in Attachment 3. Box plots for arsenic (both IDEU and background) are provided in Attachment 3. Arsenic is the only PCOC that was statistically greater than background at the 0.1 significance level and is evaluated further in the professional judgment section.

2.1.5 Surface Soil/Surface Sediment Professional Judgment Evaluation

Based on the weight of available evidence evaluated by professional judgment, PCOCs will either be included for further evaluation as COCs or excluded as COCs. The professional judgment evaluation takes into account process knowledge, spatial trends, risk potential, and pattern recognition. As discussed in Section 1.2 and Attachment 2, the

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sample results are adequate for use in the professional judgment because they are of sufficient quality for use in the CRA.

Based on the weight of evidence described in Attachment 3, arsenic in surface soil/surface sediment in the IDEU is not considered a COC because the weight of evidence supports the conclusion that arsenic concentrations in surface soil/surface sediment in the IDEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations.

2.2 Contaminant of Concern Selection for Subsurface Soil/Subsurface Sediment

Detected PCOCs in subsurface soil/subsurface sediment samples (Table 1.4) are screened in accordance with the CRA Methodology to identify the COCs.

2.2.1 Subsurface Soil/Subsurface Sediment Cation/Anion and Essential Nutrient Screen

The major cations and anions that do not have toxicity criteria were eliminated from assessments in subsurface soil/subsurface sediment in accordance with the CRA Methodology.

Essential nutrients without toxicity criteria that were detected in subsurface soil/subsurface sediment at the IDEU were compared to DRIs in Table 2.4. The estimated daily maximum intakes for these PCOCs, based on the nutrient's MDCs and a subsurface soil/subsurface sediment ingestion rate of 100 mg/day, are less than the DRIs. Therefore, these PCOCs were not further evaluated as COCs for subsurface soil/subsurface sediment.

2.2.2 Subsurface Soil/Subsurface Sediment Preliminary Remediation Goal Screen

The PRG screen for detected analytes in subsurface soil/subsurface sediment is presented in Table 2.5. The MDC and UCL for radium-228 in subsurface soil/subsurface sediment were greater than the PRG; therefore radium-228 was retained for further evaluation in the COC selection process in the IDEU.

PRGs were not available for several PCOCs in subsurface soil/subsurface sediment. Analytes without PRGs are listed in Table 2.5, and their effect on the conclusions of the risk assessment results is discussed in the uncertainty section (Section 6.0).

2.2.3 Subsurface Soil/Subsurface Sediment Detection Frequency Screen

The detection frequency screen was not performed for radium-228 in subsurface soil/subsurface sediment because all reported values for radionuclides are considered detects.

2.2.4 Subsurface Soil/Subsurface Sediment Background Analysis

Analyses were conducted to asses whether radium-228 activities in IDEU subsurface soil/subsurface sediment are statistically higher than those in background subsurface soil/subsurface sediment at the 0.1 level of significance (1-p less than or equal to 0.1). The subsurface soil/subsurface sediment background data are described in detail in Appendix A, Volume 2 of the RI/FS Report.

The results of the statistical comparisons of the IDEU data to the background data indicate site activities for radium-228 are not statistically greater than background at the 0.1 significance level. The results are summarized in Table 2.3 and in Attachment 3. Box plots for radium-228 (both IDEU and background) are provided in Attachment 3. Radium-228 in subsurface soil/subsurface sediment was not further evaluated in the COC screening process.

2.2.5 Subsurface Soil/Subsurface Sediment Professional Judgment Evaluation

The professional judgment step was not performed for subsurface soil/subsurface sediment because there were no PCOCs with concentrations statistically greater than background concentrations.

2.3 Contaminant of Concern Selection Summary

A summary of the results of the COC screening process is presented in Table 2.6. No COCs were selected for any of the media at the IDEU.

3.0 HUMAN HEALTH EXPOSURE ASSESSMENT

The site conceptual model (SCM), presented in Figure 2.1 of the CRA Methodology and discussed in Appendix A, Volume 2 of the RI/FS Report, provides an overview of potential human exposures for reasonably anticipated land use at RFETS. However, all PCOCs were eliminated from further consideration as human health COCs for the IDEU based on comparisons of MDCs and UCLs to PRGs, background comparisons, or professional judgment (see Section 2.0). A quantitative risk characterization is not necessary for the IDEU; therefore an exposure assessment was not conducted.

4.0 HUMAN HEALTH TOXICITY ASSESSMENT

Procedures and assumptions for the toxicity assessment are presented in the CRA Methodology (DOE 2004a). All PCOCs were eliminated from further consideration as human health COCs for the IDEU based on comparisons of MDCs and UCLs to PRGs, background comparisons, or professional judgment (see Section 2.0). A quantitative risk characterization is not necessary for the IDEU; therefore a toxicity assessment was not conducted.

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5.0 HUMAN HEALTH RISK CHARACTERIZATION

Information from the exposure assessment and the toxicity assessment has been incorporated into this section to characterize risk to the WRW and WRV receptors. All PCOCs were eliminated from further consideration as human health COCs based on comparisons of MDCs and UCLs to PRGs, background comparisons, or professional judgment (see Section 2.0). Therefore, a quantitative risk characterization was not performed for the IDEU.

6.0 UNCERTAINTIES ASSOCIATED WITH THE HUMAN HEALTH RISK ASSESSMENT

There are various types of uncertainties that are associated with the steps comprising an HHRA. General uncertainties common to the EUs are discussed in Appendix A, Volume 2 of the RI/FS Report. Uncertainties specific to the EU are described below.

6.1 Uncertainties Associated with the Data

Data adequacy for this CRA is evaluated and discussed in Appendix A, Volume 2 of the RI/FS Report. Although there are some uncertainties associated with the sampling and analyses conducted for surface soil/surface sediment and subsurface soil/subsurface sediment at the IDEU, data are considered adequate for the characterization of risk at the EU. The environmental samples for the IDEU were collected from 1992 through 2004. The CRA sampling and analysis requirements for the BZ (DOE 2004, 2005a) specify that the minimum sampling density requirement for surface soil/surface sediment is one five-sample composite for every 30-acre grid cell. In surface soil/surface sediment, there are up to 83 samples in the IDEU. Although there is limited data for organics in surface soil/surface sediment, there are no known or suspected sources for organic contaminants in the IDEU. In subsurface soil/subsurface sediment, there are up to 72 samples in the IDEU.

Another source of uncertainty in the data is the relationship of detection limits to the PRGs for analytes eliminated as COCs because they were not detected or had a low detection frequency (i.e., less than 5 percent). The detection limits were appropriate for the analytical methods used, and this is examined in greater detail in Attachment 1.

6.2 Uncertainties Associated with Screening Values

The COC screening analyses used RFETS-specific PRGs based on a WRW scenario. The assumptions used in the development of these values were conservative. For example, it is assumed that a future WRW will consume 100 milligrams (mg) of surface soil/surface sediment for 230 days per year for a period of 18.7 years. In addition, a WRW is assumed to be dermally exposed and to inhale surface soil and surface sediment particles in the air. These assumptions are likely to overestimate actual exposures to surface soil for WRWs

in the IDEU because a WRW will not spend 100 percent of his or her time in this area. Exposure to subsurface soil and subsurface sediment is assumed to occur 20 days per year. The WRW PRGs for subsurface soil/subsurface sediment are also expected to conservatively estimate potential exposures because it is unlikely that a WRW will excavate extensively in the IDEU.

6.2.1 Uncertainties Associated with Potential Contaminants of Concern without Preliminary Remediation Goals

PCOCs for the IDEU for which PRGs are not available are listed in Table 6.1.

Uncertainties associated with the lack of PRGs for analytes listed in Table 6.1 are considered small. The listed inorganics are not usually included in HHRAs because they are not expected to result in significant human health impacts. Radionuclide PRGs are available for all detected individual radionuclides. Therefore, the lack of PRGs for the gross alpha and gross beta activities is not expected to affect the results of the HHRA.

6.3 Uncertainties Associated with Eliminating Potential Contaminants of Concern Based on Professional Judgment

Arsenic in surface soil/surface sediment was eliminated as a COC based on professional judgment. There is no identified source or pattern of release in the IDEU, and the slightly elevated median value of arsenic in the IDEU is most likely due to natural variation. The weight of evidence presented in Attachment 3, Section 4.0, supports the conclusion that concentrations of arsenic are naturally occurring and are not the result of site activities. Uncertainty associated with the elimination of this chemical as a COC is low.

No PCOCs were eliminated in subsurface soil/subsurface sediment based on professional judgment in the IDEU.

6.4 Uncertainties Evaluation Summary

An evaluation of the uncertainties associated with the data and the COC screening processes indicates there is reasonable confidence in the conclusions of the IDEU risk characterization.

7.0 IDENTIFICATION OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN

The ECOPC identification process streamlines the ecological risk characterization for each EU by focusing the assessment on ECOIs that are present in the IDEU. ECOIs are defined as any chemical detected in the IDEU and are assessed for surface soils and subsurface soils. ECOIs for sediments and surface water are assessed in Appendix A, Volume 15 of the RI/FS Report. The ECOPC process is described in the CRA

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Methodology and additional details are provided in Appendix A, Volume 2 of the RI/FS Report.

The process is based on the site conceptual model (SCM) presented in the CRA Methodology and described in detail in Appendix A, Volume 2 of the RI/FS Report. The SCM presents the pathways of potential exposure from documented historical source areas (IHSSs and PACs) to the receptors of concern. Generally, the most significant exposure pathways for wildlife at the IDEU are the ingestion of plant, invertebrate, or animal tissue that could have accumulated ECOIs from the source areas through direct uptake or dietary routes, as well as the direct ingestion of potentially contaminated media. For terrestrial plants and invertebrates, the most significant exposure pathway is direct contact with potentially contaminated soil.

The receptors of concern that were selected for assessment are listed in Table 7.1 and discussed in detail in Appendix A, Volume 2 of the RI/FS Report, and include representative birds and mammals in addition to the general plant and terrestrial invertebrate communities. The receptors were selected based on several criteria, including their potential to be found in the various habitats present within RFETS, their potential to come into contact with ECOIs, and the amount of life history and behavioral information available.

The ECOPC process consists of two separate evaluations, one for the PMJM receptor and one for non-PMJM receptors. The ECOPC identification process for the PMJM is conducted separately from non-PMJM receptors because the PMJM is a federally listed threatened species under the Endangered Species Act (63 FR 26517).

7.1 Data Used in the Ecological Risk Assessment

The following IDEU data are used in the CRA:

- A total of 81 surface soil samples were collected and analyzed for inorganics (64 samples), organics (three samples), and radionuclides (81 samples) (Table 1.2), and
- A total of 72 subsurface soil samples were collected and analyzed for inorganics (72 samples), organics (65 samples), and radionuclides (70 samples) (Table 1.2).

A data summary is provided in Table 1.5 for surface soil, Table 1.6 for surface soil in PMJM habitat, and Table 1.7 for subsurface soil.

Sediment and surface water data for the IDEU also were collected (Section 1.2), and these data are evaluated for the ERA in Appendix A, Volume 15 of the RI/FS Report.

The IDEU has seven sample locations occurring in the PMJM habitat, which is described in greater detail in Section 1.1.4. Sampling locations and PMJM habitat patches within the IDEU are shown on Figure 1.5.

7.2 Identification of Surface Soil Ecological Contaminants of Potential Concern

ECOPCs for surface soil were identified for non-PMJM and PMJM receptors in accordance with the sequence presented in the CRA Methodology.

7.2.1 Comparison with No Observed Adverse Effect Level Ecological Screening Levels

In the first step of the ECOPC identification process, the MDCs of ECOIs in surface soil were compared to receptor-specific no observed adverse effect level (NOAEL) ESLs. NOAEL ESLs for surface soil were developed in the CRA Methodology for three receptor groups: terrestrial vertebrates, terrestrial invertebrates, and terrestrial plants.

Non-PMJM Receptors

The NOAEL ESLs for non-PMJM receptors are compared to MDCs in surface soil in Table 7.1. The results of the NOAEL ESL screening analyses for all receptor types are summarized in Table 7.2. Analytes with a "Yes" in any of the "Exceedance" columns in Table 7.2 are evaluated further.

NOAEL ESLs were not available for several ECOI/receptor pairs (Tables 7.1 and 7.2). These ECOI/receptor pairs are discussed as ECOIs with uncertain toxicity (UT) in Section 10.0 along with the potential impacts to the risk assessment.

PMJM Receptors

The NOAEL ESLs for PMJM receptors were compared to the MDCs of ECOIs in surface soil collected from PMJM habitat (Table 7.3). The MDCs in surface soil that exceed the NOAEL ESLs are identified in Table 7.3 with a "Yes" in the column heading "EPC>PMJM ESL?"

Analytes for which a PMJM NOAEL ESL is not available are identified with a "N/A" in Table 7.3 under the column heading "PMJM NOAEL ESL." These analytes are discussed in the uncertainty section (Section 10.0) as ECOIs with UT.

7.2.2 Surface Soil Frequency of Detection Evaluation

The ECOPC identification process for non-PMJM receptors involves an evaluation of detection frequency for each ECOI retained after the NOAEL screening step. If the detection frequency is less than 5 percent, then population-level risks are considered highly unlikely and the ECOI is not further evaluated. None of the chemicals detected in surface soil at the IDEU that were retained after the NOAEL ESL screening step had a detection frequency less than 5 percent. Therefore, no ECOIs were excluded based on the detection frequency evaluation for surface soil in the IDEU.

7.2.3 Surface Soil Background Comparisons

The ECOIs retained after the NOAEL ESL screening and the detection frequency evaluation were then compared to site-specific background concentrations where

available. The background comparison is presented in Table 7.3 and discussed in Attachment 3. The statistical methods used for the background comparison are summarized in Appendix A, Volume 2 of the RI/FS Report.

Non-PMJM Receptors

The results of the background comparisons for the non-PMJM receptors are presented in Table 7.4. The analytes listed as being retained as ECOIs in Table 7.4 are evaluated further using upper-bound EPCs in the following section.

PMJM Receptors

The background comparisons for PMJM receptors are conducted differently than for non-PMJM receptors because of their protected status. The results of this comparison are based on their location within PMJM habitat and are presented in Table 7.5. Attachment 3 presents further discussion of the PMJM background analysis. The analytes listed as "Yes" on Table 7.5 are further evaluated in the following sections.

7.2.4 Upper-Bound Exposure Point Concentration Comparisons to Threshold ESL

The ECOIs retained after completion of all previous evaluations for non-PMJM receptors were then compared to threshold ESLs (tESLs) using upper-bound EPCs that are specific to small and large home-range receptors. The calculation of EPCs is described in Attachment 3.

Statistical concentrations for each ECOI retained for the tESL screen are presented in Table 7.6. The EPC for small home-range receptors is the 95 percent UCL of the 90th percentile (upper tolerance limit [UTL]), or the MDC in the event that the UTL is greater than the MDC. The EPC for large home-range receptors is the UCL, or the MDC in the event that the UCL is greater than the MDC.

Small home-range receptors include terrestrial plants, terrestrial invertebrates, mourning dove, American kestrel, deer mouse, and black-tailed prairie dog. These receptors are evaluated by comparing the small home-range EPC (UTL) for each ECOI to the limiting (or lowest) small home-range receptor tESL (if available). In the event that tESLs are not available, the limiting NOAEL ESL is used in accordance with the CRA Methodology.

Large home-range receptors, such as coyote and mule deer, are evaluated by comparing the large home-range EPC (UCL) for each ECOI to the limiting large home-range receptor tESL (if available). In the event that tESLs are not available, the limiting NOAEL ESL is used in accordance with the CRA Methodology.

The EPC comparison to limiting tESLs for small and large home-range receptors is presented in Table 7.7. Analytes that exceed the limiting tESLs are further evaluated by comparing them to the receptor-specific tESLs (if available) to identify receptors of potential concern. Analytes exceeding the limiting tESLs for small home-range receptors are compared to receptor-specific tESLs in Table 7.8. There are no analytes exceeding limiting tESLs for large home-range receptors for the IDEU.

The EPC comparison to limiting tESLs for small and large home-range receptors is presented in Table 7.5. Analytes exceeding the limiting tESLs for small home-range receptors are compared to receptor-specific tESLs in Table 7.6. No analytes exceeded the limiting tESLs for large home-range receptors.

Chemicals that exceed any tESLs (if available) are assessed in the professional judgment evaluation. Any analyte/receptor pairs that are retained through professional judgment are identified as ECOPCs and are carried forward in the risk characterization.

7.2.5 Surface Soil Professional Judgment Evaluation

Non-PMJM Receptors

Based on the weight-of-evidence, professional judgment described in Attachment 3, aluminum, arsenic, boron, chromium, lithium, and tin in surface soil at the IDEU were not considered ECOPCs for non-PMJM receptors and are not further evaluated quantitatively.

Antimony and lead were identified as ECOPCs and retained for further evaluation in the risk characterization.

PMJM Receptors

ECOIs in PMJM habitat with surface soil concentrations that exceed NOAEL ESLs and have elevated concentrations compared to background data are subject to a professional judgment evaluation. However, no ECOIs in PMJM habitat had surface soil concentrations that exceeded background; therefore, no weight-of-evidence, professional judgment evaluation was needed for the IDEU.

7.2.6 Summary of Surface Soil Ecological Contaminants of Potential Concern

The ECOPC screening process for surface soil is summarized in the following section for non-PMJM receptors and PMJM receptors.

Non-PMJM Receptors

Inorganic, organic, and radionuclide surface soil ECOIs for non-PMJM receptors in the IDEU were eliminated from further consideration as ECOPCs based on one of the following: 1) the MDC of the ECOI was less than the lowest ESL; 2) no ESLs were available (these ECOIs are discussed in Section 10.0); 3) the concentration of the ECOI in IDEU surface soils was not statistically greater than background surface soils; 4) the upper-bound EPC did not exceed the limiting tESL; or 5) the weight-of-evidence, professional judgment evaluation indicated that the ECOI was not a site-related contaminant of potential concern. Chemicals that were retained are identified as ECOPCs.

A summary of the ECOPC screening process for non-PMJM receptors is presented in Table 7.9. Receptors of potential concern for each ECOPC are also presented. The ECOPC/receptor pairs are evaluated further in Section 8.0 (Ecological Exposure

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Assessment), Section 9.0 (Ecological Toxicity Assessment), and Section 10.0 (Ecological Risk Characterization).

PMJM Receptors

ECOIs in surface soil in PMJM habitat located within the IDEU were evaluated in the ECOPC identification process. ECOIs were removed from further evaluation in the ECOPC identification process based on one of the following: 1) the MDC of the ECOI was less than the NOAEL ESL for PMJM; 2) no NOAEL ESLs were available (these ECOIs are discussed in Section 10.0); 3) the ECOI concentrations within the PMJM habitat in the IDEU were not statistically greater than those from background surface soils; or 4) the weight-of-evidence, professional judgment evaluation indicated that the ECOI was not a site-related contaminant of potential concern. The results of the ECOPC identification process for the PMJM are summarized in Table 7.10.

7.3 Identification of Subsurface Soil Ecological Contaminants of Potential Concern

Subsurface soil sampling locations for soil is collected at a starting depth of 0.5 to 8 feet bgs in the IDEU are identified on Figure 1.7. A data summary for subsurface soil less than 8 feet deep is presented in Table 1.7.

7.3.1 Comparison to No Observed Adverse Effect Level Ecological Screening Levels

The CRA Methodology indicates subsurface soil must be evaluated for those ECOIs that have greater concentrations in subsurface soil than in surface soil. As a conservative screening step, subsurface soil is evaluated for all EUs regardless of the presence/absence of a change in concentrations from surface soil and subsurface soil. The MDCs of ECOIs in subsurface soil were compared to NOAEL ESLs for burrowing receptors (Table 7.11). ECOIs with MDCs greater than the NOAEL ESL for the prairie dog are further evaluated in the ECOPC identification process.

NOAEL ESLs are not available for some analytes, and these are identified as "N/A" in Table 7.11. These constituents are considered ECOIs with UT and are discussed in the uncertainty analysis (Section 10.0).

7.3.2 Subsurface Soil Detection Frequency Evaluation

The ECOPC identification process for burrowing receptors involves an evaluation of detection frequency for each ECOI retained after the NOAEL ESL screening step. If the detection frequency is less than 5 percent, population-level risks are considered highly unlikely and the ECOI is not further evaluated. The detection frequencies for chemicals in subsurface soil are presented in Table 1.7. None of the chemicals in subsurface soil at the IDEU that were retained after the NOAEL ESL screening step had a detection frequency of less than 5 percent. Therefore, no ECOIs were eliminated from further evaluation based on low detection frequencies for subsurface soil in the IDEU.

7.3.3 Subsurface Soil Background Comparison

The ECOIs retained after the ESL screening and detection frequency evaluation were compared to site-specific background concentrations where available. The background comparison was conducted in the same manner as that for surface soil non-PMJM receptors using statistical comparisons.

Analyses were conducted to assess whether arsenic, mercury, nickel, and vanadium in IDEU subsurface soil are statistically greater than those in sitewide background surface soil at the 0.1 level of significance. Statistical comparisons could not be completed for mercury because detection frequencies for either the background data set or IDEU data sets were too low. Mercury is evaluated further using upper-bound EPCs in the following section.

The results of the statistical comparisons of the IDEU data to background data indicate that site concentrations of arsenic, nickel, and vanadium in IDEU subsurface soil are not statistically greater than background concentrations. The results are summarized in Table 7.12. Box plots for these ECOIs (background and IDEU) are presented in Attachment 3 and support the results of the Wilcoxon Rank Sum (WRS) statistical comparisons. These ECOIs were eliminated as ECOPCs and were not evaluated further.

7.3.4 Upper-Bound Exposure Point Concentration Comparisons to Threshold ESLs

ECOIs retained after all previous evaluations for burrowing receptors are compared to tESLs using upper-bound EPCs specific to small home-range receptors. The calculation of EPCs is discussed in the CRA Methodology.

Because only mercury was retained following the background analysis step, statistical concentrations for mercury are presented in Table 7.13. The EPC comparison to tESLs for burrowing receptors is presented in Table 7.14. The subsurface soil UTL for mercury is lower than the tESL for the prairie dog receptor; therefore, it was not evaluated further.

7.3.5 Subsurface Soil Professional Judgment

ECOIs with subsurface soil concentrations that exceed NOAEL ESLs, which have been detected in more than 5 percent of samples; have slightly elevated concentrations compared to the background data; and that exceed tESLs are subject to a professional judgment evaluation. However, no ECOIs had subsurface soil concentrations that exceeded tESLs; therefore, no weight-of-evidence, professional judgment evaluation was needed for subsurface soil in the IDEU.

7.3.6 Summary of Subsurface Soil Ecological Contaminants of Potential Concern

All subsurface soil ECOIs for burrowing receptors in the IDEU were eliminated from further consideration as ECOPCs based on one of the following: 1) the MDC of the ECOI was less than NOAEL ESL for the burrowing receptor; 2) no ESLs were available (these ECOIs are discussed in Section 10.0); 3) the concentration of the ECOI in IDEU

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subsurface soils was not greater than background subsurface soils; or 4) the upper-bound EPC was less than the tESL. The results of the subsurface soil ECOPC identification process for burrowing receptors are summarized in Table 7.15.

7.4 Summary of Ecological Contaminants of Potential Concern

ECOIs in surface and subsurface soil in the IDEU were evaluated in the ECOPC identification process for non-PMJM receptors, PMJM receptors, and burrowing receptors. Antimony and lead were identified as ECOPCs for selected non-PMJM receptors (Table 7.9). No chemicals were identified as ECOPCs for the PMJM (Table 7.10). No chemicals were identified as ECOPCs for burrowing receptors (Table 7.15). No other ECOIs were retained past the professional judgment step of the ECOPC identification process for any other receptor group (non-PMJM receptors, PMJM receptors, or burrowing receptors).

8.0 ECOLOGICAL EXPOSURE ASSESSMENT

The ECOPC identification process defined the steps necessary to identify those chemicals that could not reliably be removed from further consideration in the ERA process. The list of ECOPC/receptor pairs of potential concern (Table 8.1) represents those media, chemicals, and receptors in the IDEU that require further assessment. The characterization of risk defines a range of potential exposures to site receptors from the ECOPCs and a parallel evaluation of the potential toxicity of each of the ECOPCs as well as the uncertainties associated with the risk characterization. This section provides the estimation of potential exposure to surface soil ECOPCs for the receptors identified in Section 7.0 and Table 8.1. Details of the two exposure models, concentration-based exposure and dosage-based exposure, are presented in Appendix A, Volume 2 of the RI/FS Report.

8.1 Exposure Point Concentrations

Surface soil EPCs for all non-PMJM receptors were calculated using both Tier 1 and Tier 2 methods, as described in the CRA Methodology. The 30-acre grid used for the Tier 2 calculations is shown in Figure 8.1. The Tier 1 and Tier 2 UTLs and UCLs are presented in Table 8.2. The methodology for the calculation of Tier 2 statistics in provided in the RI/FS Report Appendix A, Attachment 2.

Surface water EPCs consisted of values that corresponded to the soil EPCs (only for the soil ECOPCs) being used. Surface water EPCs are used to estimate the total exposure via the surface water ingestion pathway. For example, if the soil EPC statistic was the UCL, then the UCL concentration in surface water (total concentrations only) was selected as the EPC. Surface water EPCs for all ECOPCs were calculated as described for soils and are presented in Table 8.4. All surface water data are provided on the CD in Attachment 6.

8.2 Receptor-Specific Exposure Parameters

Receptor-specific exposure factors are needed to estimate exposure to ECOPCs for each representative species. Specific factors include body weight; food, water, and media ingestion rates; and diet composition and respective proportion of each dietary component. Daily rates for intake of forage, prey, water, and incidental ingestion of soils were developed in the CRA Methodology and are presented in Table 8.4 for the receptors of potential concern carried forward in the ERA for the IDEU.

8.3 Bioaccumulation Factors

The measurement or estimation of concentrations of ECOPCs in wildlife food is necessary to evaluate how much of a receptor's exposure is via food versus direct uptake of contaminated media. Conservative bioaccumulation factors (BAFs) were identified in the CRA Methodology. These BAFs are either simple ratios between chemical concentrations in biota and soil or are based on quantitative relationships such as linear, logarithmic, or exponential equations. The values reported in the CRA Methodology are used as the BAFs for purposes of risk estimation.

8.4 Intake and Exposure Estimates

Intake and exposure estimates were completed for each ECOPC/receptor pair identified in Table 8.1. The estimates use the default exposure parameters and BAFs that are presented in Appendix B of the CRA Methodology and described in the previous subsection. These intake calculations represent conservative estimates of food tissue concentrations calculated from the range of upper-bound EPCs including the Tier 1 and Tier 2 UTLs and UCLs, where appropriate.

Non-PMJM Receptors

The intake and exposure estimates for ECOPC/non-PMJM receptor pairs are presented in Attachment 4. A summary of the exposure estimates is presented in Table 8.5.

- Antimony – Exposure estimates for the deer mouse (insectivore).
- Lead – Exposure estimates for the mourning dove (herbivore and insectivore).

9.0 ECOLOGICAL TOXICITY ASSESSMENT

Exposure to wildlife receptors was estimated for representative species of functional groups based on taxonomy and feeding behavior in Section 8.0 in the form of a daily rate of intake for each ECOPC/receptor pair. To estimate risk, soil concentrations (plants and invertebrate exposure) and calculated intakes (birds and mammals) must then be compared to the toxicological properties of each ECOPC. The laboratory-based toxicity benchmarks are termed toxicity reference values (TRVs) and are of several basic types. The NOAEL and no observed effect concentration (NOEC) TRVs are intake rates or soil

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concentrations below which no ecologically significant effects are expected. The NOAEL and NOEC TRVs were used to calculate the NOAEL ESLs used in screening steps of the ECOPC identification process to eliminate chemicals that do not have the potential to cause risk to the representative receptors. The lowest observed adverse effects level (LOAEL) TRV is a concentration above which the potential for some ecologically significant adverse effect could be elevated. The threshold TRVs represent the hypothetical dose at which the response for a group of exposed organisms may first begin to be significantly greater than the response for unexposed receptors and is calculated as the geometric mean of the NOAEL and LOAEL. Threshold TRVs were calculated based on specific data quality rules for use in the ECOPC identification process for a small subset of ECOIs in the CRA Methodology.

TRVs for ECOPCs identified for the IDEU were obtained from the CRA Methodology. The pertinent TRVs for the IDEU are presented for birds and mammals in Table 9.1.

10.0 ECOLOGICAL RISK CHARACTERIZATION

Risk characterization includes risk estimation and risk description. Details of these components are described in the CRA Methodology and Appendix A, Volume 2 of the RI/FS Report. Predicted risks should be viewed in terms of the potential for the assumptions used in the risk characterization to occur in nature, the uncertainties associated with the assumptions, and in the potential for effects on the population of receptors that could inhabit the IDEU.

Potential risks to terrestrial plants, invertebrates, birds, and mammals are evaluated using a hazard quotient (HQ) approach. An HQ is the ratio of the estimated exposure of a receptor to a TRV that is associated with a known level of toxicity, either a no effect level (NOAEL or NOEC) or an effect level (LOAEL or LOEC):

$$HQ = \text{Exposure} / \text{TRV}$$

As described in Section 8.0, the units used for exposure and TRV depend upon the type of receptor evaluated. For plants and invertebrates, exposures and TRVs are expressed as concentrations (mg/kg soil). For birds and mammals, exposures and TRVs are expressed as ingested doses (mg/kg/BW/day). In general, if the NOAEL-based HQ is less than 1, then no adverse effects are predicted. If the LOAEL-based HQ is less than 1 but the NOAEL-based HQ is above 1, then some adverse effects are possible. However, in this situation it is expected that the magnitude and frequency of the effects will usually be low (assuming the magnitude and severity of the response at the LOAEL are not large and the endpoint of the LOAEL accurately reflects the assessment endpoints for that receptor). If the LOAEL-based HQ is greater than or equal to 1, then the risk of an adverse effect is of potential concern, with the probability and/or severity of effect tending to increase as the value of the HQ increases.

When interpreting HQ results for non-PMJM ecological receptors, it is important to remember that the assessment endpoint to non-PMJM receptors is based on the sustainability of exposed populations, and risks to some individuals in a population may

be acceptable if the population is expected to remain healthy and stable. For threatened and endangered species, such as the PMJM, the interpretation of HQ results is based on potential risks to individuals rather than populations.

HQs were calculated for each ECOPC/receptor pair based on the exposures estimated and TRVs presented in the preceding sections. Risks are discussed and presented to put the assumptions of the risk predictions into a context that can be used to make risk management decisions.

10.1 Chemical Risk Characterization

Chemical risk characterization involves quantitative methods to evaluate potential risks to ecological receptors. In this risk assessment, the quantitative method used to characterize chemical risk is the HQ approach. As noted above, HQs are usually interpreted as follows:

HQ Values		Interpretation of HQ Results
NOAEL-based	LOAEL-based	
≤ 1	≤ 1	Minimal or no risk
> 1	≤ 1	Low level risk[a]
> 1	> 1	Potentially significant risk

[a] Assuming magnitude and severity of response at LOAEL are relatively small and based on endpoints appropriate for the assessment endpoint of the receptor considered.

One potential limitation of the HQ approach is that calculated HQ values may sometimes be uncertain due to simplifications and assumptions in the underlying exposure and toxicity data used to derive the HQs. Where possible, this risk assessment provides information on three potential sources of uncertainty, as described below.

- **EPCs.** Because surface soil sampling programs in the EU sometimes tended to focus on areas of potential contamination (IHSS/PAC/UBCs), EPCs calculated using the Tier 1 approach (which assumes that all samples are randomly spread across the EU and are weighted equally) may tend to yield an EPC that is biased high. For this reason, a Tier 2 area-weighting approach was used to derive additional EPCs that help compensate for this potential bias. HQs were always calculated based on both Tier 1 and Tier 2 EPCs for non-PMJM receptors. No Tier 2 EPCs were calculated for PMJM receptors due to the limited size of their habitat.

- **BAFs.** For wildlife receptors, concentrations of contaminants in dietary items were estimated from surface soil using uptake equations. When the uptake equation was based on a simple linear model (e.g., $C_{tissue} = BAF * C_{soil}$), the default exposure scenario used a high-end estimate of the BAF (the 90th percentile BAF). However, the use of high-end BAFs may tend to overestimate tissue concentrations in some dietary items. Where necessary, to estimate more

typical tissue concentrations, an alternative exposure scenario was used that calculated total chemical intake using a 50th percentile (median) BAF. The use of the median BAF is consistent with the approach used in the ecological soil screening level (EcoSSL) guidance (EPA 2005).

- **TRVs.** An established hierarchy was used in the CRA Methodology to identify the most appropriate default TRVs for use in the ECOPC selection. However, in some instances, the default TRV selected may be overly conservative with regard to characterizing population-level risks. The determination of whether the default TRVs are thought to yield overly conservative estimates of risk is addressed on a chemical-by-chemical basis in the uncertainty sections below. Furthermore, the chemical-specific uncertainty sections include a discussion of why an identified alternative TRV is thought to be appropriate in providing an estimate of toxicity (e.g., endpoint relevance, species relevance, data quality, chemical form, etc.). Where necessary, HQs were calculated using both default and alternative TRVs.

The influences of each of these uncertainties on the calculated HQs were evaluated both alone and in concert in the risk description for each chemical. Uncertainties related to the BAFs, TRVs, and background risk are presented for each chemical in Attachment 5. Where uncertainties were deemed to be high, Attachment 5 provides alternative BAFs and/or TRVs as appropriate based on the results of the uncertainty assessment.

HQs calculated using the default BAFs and HQs with the Tier 1 and Tier 2 EPCs are provided in Table 10.1 for each ECOPC/Receptor pair. Where no LOAEL HQs exceed 1 using the default exposure and toxicity values, no further HQs were calculated regardless of the results of the uncertainty analysis. Because the default HQs are generally the most conservative risk estimations, if low risk is estimated using these values then further reductions of conservatism would only serve to reduce risk estimates further.

Where LOAEL HQs greater than 1 are calculated using default assumptions, and the uncertainty analysis indicated that alternative BAFs and/or TRVs would be beneficial to reduce uncertainty and conservatism, alternative HQs are presented in Table 10.1 as appropriate.

The selection of which EPC (e.g., UTL or UCL) is of primary importance and will depend on the type of receptor and the relative home-range size. Only the UTL EPC is provided in Table 10.1 for small home-range receptors, and only the UCL is provided for large home-range receptors. Only small home-range receptors are of concern in the IDEU.

All calculated exposure estimates and HQ values are provided in Attachment 4. These include the default and alternative HQs and are calculated using a range of EPCs. The results for each ECOPC are discussed in more detail below.

The risk description incorporates results of the risk estimates along with the uncertainties associated with the risk estimates and other lines of evidence to evaluate potential chemical effects on ecological receptors in the IDEU following accelerated actions at

RFETS. Information considered in the risk description includes receptor groups potentially affected, type of TRV exceeded (e.g., NOAEL versus LOAEL), relation of EU concentrations to other criteria such as EPA EcoSSLs, and risk above background conditions. In addition, other site-specific and regional factors are considered such as the use of a given ECOPC within the EU related to historical RFETS activities, comparison of ECOPC concentrations within the IDEU to the rest of the RFETS site as it relates to background, and/or comparison to regional background concentrations.

10.1.1 Antimony

Antimony HQs for the deer mouse (insectivore) are presented in Table 10.1. Figure 10.1 shows the spatial distribution of antimony in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

HQs Calculated to Characterize Uncertainty

Uncertainties related to the default HQ calculations provided in Table 10.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

For the deer mouse (insectivore), the only non-PMJM receptor, LOAEL HQs were less than 1 using the default exposure assumptions; therefore, no alternative HQs were presented in Table 10.1.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

Antimony – Risk Description

Antimony was identified as an ECOPC for the deer mouse (insectivore). No alternative HQs were calculated for the deer mouse. Information on the historical use provided in Appendix A, Volume 2, Attachment 8, of the RI/FS Report and a summary of site data and background data are provided in Attachment 3. At the largest IHSS, the West Spray Field, antimony was not identified as a COC for human receptors.

Non-PMJM Receptors – Small Home-Range

NOAEL HQs using default risk models were greater than 1 for the deer mouse (insectivore). LOAEL HQs were less than 1 for the deer mouse (insectivore). Risks to populations of the deer mouse (insectivore) from exposure to antimony are likely to be low.

Table 10.2 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Antimony samples were available from 41 grid cells (Figure 10.1). NOAEL HQs greater than 1 were calculated in 32 percent of the grid cells, and no LOAEL HQs greater than 1 were calculated in any grid cell for the deer mouse (insectivore). The results of the grid-cell analysis indicate that the average exposure to sub-populations of deer mice (insectivore) results in low risk from exposure to antimony.

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10.1.2 Lead

Lead HQs for the mourning dove (herbivore and insectivore) are presented in Table 10.1. Lead was not identified as an ECOPC in the IDEU for any other receptors. Figure 10.2 shows the spatial distribution of lead in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

HQs Calculated to Characterize Uncertainty

Uncertainties related to the default HQ calculations provided in Table 10.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

No alternative BAFs or TRVs were presented in Attachment 5, therefore no alternative HQs have been calculated.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

Lead Risk Description

Lead was identified as an ECOPC for the mourning dove (herbivore and insectivore) receptors only. Information on the historical use provided in Appendix A, Volume 2, Attachment 8, of the RI/FS Report and a summary of site data and background data are provided in Attachment 3. At the largest IHSS, the West Spray Field, lead was not identified as a COC for human receptors.

Non-PMJM Receptors – Small Home-Range

NOAEL and LOAEL HQs using default risk models were greater than 1 for the mourning dove (insectivore). NOAEL and LOAEL HQs were less than or equal to 1 for the mourning dove (herbivore). Risks to populations of the mourning dove (herbivore) from exposure to lead are likely to be low. Risks to the mourning dove (insectivore) using the default HQ calculations may potentially be significant and require further evaluation.

Table 10.2 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Lead samples were available from 41 grid cells (Figure 10.2). NOAEL HQs greater than 1 were calculated in 97 percent of the grid cells while 92 percent of the LOAEL HQs greater than 1 were calculated in any grid cell for the most sensitive receptor (mourning dove [insectivore]). Only 2 percent of the LOAEL HQs (one grid cell) were greater than 5 for the mourning dove (insectivore). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in potentially significant risk from exposure to lead.

The uncertainty analysis indicated that HQs calculated using the default TRV and BAFs (Tier 1 LOAEL HQ = 2 and Tier 2 LOAEL HQ = 2) are very similar to those calculated in background. LOAEL HQs for the mourning dove (insectivore) equal to 3 using the site-specific background UTL were calculated in the RI/FS Report Appendix A,

Volume 2, Attachment 9 and were discussed in Attachment 5 of this document. Because risks are not typically expected at normal background concentrations, risks to the mourning dove (insectivore) in the IDEU may be somewhat over predicted. Attachment 3 of this document indicates that the background concentrations of lead in Colorado and bordering states range from 10 to 700 milligrams per kilogram (mg/kg). The site-specific background UTL is equal to 53.3 mg/kg and does not appear to be elevated above what would be expected in the vicinity of the site. The Tier 1 IDEU UTL is equal to 62.8 mg/kg and the Tier 2 UTL is equal to 40.4 mg/kg. These lines of evidence indicate that risks predicted in IDEU are no greater than those predicted in background and that background concentrations do not appear to be elevated above what would be expected in the vicinity of the site. The combined lines of evidence indicate that although potentially significant risks are predicted using the default HQs, they may be over predicted, and the risk to populations of mourning dove (insectivore) receptors is similar to background risks and is likely to be low.

10.2 Ecosystem Characterization

An ecological monitoring program has been underway since 1991 when baseline data on wildlife species were gathered (Ebasco 1992). The purpose of this long-term program was to monitor specific habitats to provide a sitewide database from which to monitor trends in the wildlife populations at RFETS. This type of monitoring program provides localized information that can also be used for analysis at a landscape level to monitor the population trends and general health of the RFETS ecosystem. Permanent transects through three basic habitats were run monthly for more than a decade (K-H 2002). Observations were recorded concerning the abundance, distribution, and diversity of wide-ranging wildlife species, including observations of migratory birds, raptors, coyotes, and deer. Data regarding small mammal populations are limited. Small mammal monitoring occurred through several tasks in the monitoring program. The Ecological Monitoring Program (DOE 1995) established permanent transects for small mammal monitoring in three habitat types; xeric grasslands, mesic grasslands, and riparian habitats. PMJM studies established small mammal trapping in nearly all riparian habitats across the site (K-H 1998a, 1999a, 2000a, 2001a, 2002a).

Migratory birds were tracked during all seasons, but most notably during the breeding season. Over 8 years of bird survey data were collected on 18 permanent transects. Field observations were summarized into species richness and densities by habitat type. Habitats comprised the general categories of grasslands, woodlands, and wetlands. However, summaries in annual reports are grouped by habitat types across RFETS and not within EUs because EU boundaries were determined well after the monitoring program had begun. Additionally, wide-ranging animals may use habitat in several EUs and do not recognize EU boundaries.

Summarizing songbird surveys over the breeding season, diversity indices for RFETS for all habitats combined over 8 years of observations (1991, 1993-1999) show a steady state in diversity of bird communities (K-H 2000). Results among habitats were similar with the exception of an increasing trend in species richness and a decreasing trend in bird

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densities in woodland habitats. Woodland bird communities consistently show the highest diversity when compared with bird communities in wetlands and grasslands. The decreasing trend can be mostly attributed to transient species (i.e., those species not usually associated with woody cover) except for red-tailed hawk (*Buteo jamaicensis*) and American goldfinch (*Carduelis tristis*). The red-tailed hawk change in density can be attributed to a loss of nesting sites in Upper Woman Creek during the survey period. Goldfinch abundance can be heavily influenced by the availability of food sources.

A subgroup of migratory birds is neotropical migrants, which show declining populations in North America (Audubon 2005, Nature Conservancy 2005). Most of this decline is thought to be due to conversion of forest land to agriculture in the tropics and conversion to real estate development in North America. Grassland birds that are neotropical migrants are also in decline. However, over the last 5 years on RFETS, the declining trends have not been observed and densities for this group show an increase.

Raptors, big game species, and carnivores were observed through relative abundance surveys and multi-species surveys (16 permanent transects) that provide species-specific sitewide counts. Raptors were noted on relative abundance surveys and nest sites were visited repeatedly during the nesting season to confirm nesting success. The three most common raptors at RFETS are red-tailed hawk, great horned owl (*Bubo virginianus*), and American kestrel (*Falco sparverius*) (K-H 2002). One Swainson's hawk nest was noted in North Walnut Creek near the A-1 Pond, and one great horned owl nest was noted within South Walnut Creek (Ryon 2005). All nests typically fledged two young of each species, except kestrels, which usually fledged two to three young. Each species had a successful nesting season each year during the monitoring period from 1991 to 1999 with one exception. This exception was the loss of the red-tailed hawk nest in Upper Woman Creek (K-H 1997 and 1998) due to weather. The continued presence of nesting raptors at RFETS (K-H 2002) indicates that habitat quality and protection from human disturbance have contributed to making RFETS a desirable location for raptors to reproduce. Adequate habitat provides essential seasonal requirements. RFETS is estimated to be at optimum population density for raptors given the available habitat and the territorial nature of these species (K-H 2000).

Two deer species inhabit RFETS, white-tailed deer (*Odocoileus virginianus*) and mule deer (*Odocoileus hemionus*). No white-tailed deer were present at RFETS in 1991 when monitoring began (K-H 2002). In 2000 (K-H 2001), the number of white-tailed deer was estimated to be between 10 and 15 individuals. White-tailed deer frequent other areas within RFETS but spend the majority of their time in LWOEU. Mule deer frequent all parts of RFETS (14 mi^2) year-round. The RFETS population from winter counts is estimated at a mean 125 individuals (n = 7) with a density of 14 deer per square mile (K-H 2000, 2002). Winter mule deer counts have varied from 100 to 160 individuals over the monitoring period (1994 to 2000) with expected age/sex class distributions (K-H 2001). Mule deer frequent grassland hillsides during the fall and winter months. The mule deer populations from RFETS have been increasing at a steady state with good age/sex distributions (K-H 2001) over time and similar densities when compared to other "open" populations that are not hunted. This provides a good indicator that habitat quality is high and that site activities have not affected deer populations. It is unlikely that deer

populations are depressed or reproduction is affected by contaminants. A recent study on actinides in deer tissue found that plutonium levels were near or below detection limits (Todd and Sattelberg 2004). This provides further support that the deer population is healthy.

Coyotes (Canis latrans) are the top mammalian predator at RFETS. They prey upon mule deer fawns and other smaller prey species. The number of coyotes using the site has been estimated at 14 to 16 individuals (K-H 2002). Through surveys across the site, coyotes have been noted as having reproduction success with as many as six dens active in 1 year (Nelson 2003). Typically at RFETS, three to six coyote dens support an estimated 14 to 16 individuals at any given time (K-H 2001). Coyotes have exhibited a steady population over time indicating their prey species continue to be abundant and healthy.

Small mammal trapping has not occurred in the IDEU. However, small mammal habitats such as xeric grasslands throughout the EU and riparian shrublands in the upper reach of North Walnut Creek exist and likely support small mammal communities similar to those found sitewide. Vegetation communities that create small mammal habitat have been monitored in the EU through the Ecological Monitoring Program (K-H 1998b, 1999b, 2000, 2001b, 2002b), especially under the High Value Vegetation program. Continuous long-term monitoring has revealed that the flora for the site is extremely rich for an area of its size (K-H 2002b). The high diversity of vegetation communities and the undisturbed nature of the BZ, including the IDEU, support rich and diverse small mammal habitats in the EU that appear healthy and robust.

The high species diversity and continued use of the site by numerous vertebrate species verifies that habitat quality for these species remains acceptable and the ecosystem functions are being maintained (K-H 2000). Data collected on wildlife abundance and diversity indicate that wildlife populations are stable and species richness remains high during remediation activities at RFETS.

10.3 General Uncertainty Analysis

Quantitative evaluation of ecological risks is limited by uncertainties regarding the assumptions used to predict risk and the data available for quantifying risk. These limitations are usually addressed by making estimates based on the data available or by making assumptions based on professional judgment when data are limited. Because of these assumptions and estimates, the results of the risk calculations themselves are uncertain, and it is important for risk managers and the public to view the results of the risk assessment with this in mind. Chemical-specific uncertainties are presented in Attachment 5 of this document and were discussed in terms of their potential effects on the risk characterization in the risk description section for each ECOPC. A full discussion of categories of general uncertainty that are not specific to the IDEU are presented in Appendix A, Volume 2 of the RI/FS Report. The following sections are potential sources of general uncertainty that are specific to the IDEU ERA.

10.3.1 Uncertainties Associated with Data Adequacy and Quality

Sections 1.2 and 1.3 summarize the general data adequacy and data quality for the IDEU, respectively. A more detailed discussion is presented in Attachment 2 and Appendix A, Volume 2 of the RI/FS Report. The data adequacy assessment indicates that the data are adequate for the CRA. Data of sufficient quality for ERA purposes were collected in surface and subsurface soils.

10.3.2 Uncertainties Associated with the Lack of Toxicity Data for Ecological Contaminant of Interest Detected at the Inter-Drainage Exposure Unit

Several ECOIs detected in the IDEU do not have adequate toxicity data for the derivation of ESLs (CRA Methodology). These ECOIs are listed in Tables 7.1, 7.3, and 7.11 with a "UT" designation. Appendix B of the CRA Methodology outlines a detailed search process that was intended to provide high-quality toxicological information for a large proportion of the chemicals detected at RFETS. Although the toxicity is uncertain for those ECOIs that do not have ESLs calculated due to a lack of identified toxicity data, the overall effect on the risk assessment is small because the primary chemicals historically used at RFETS have adequate toxicity data for use in the CRA. Therefore, although the potential for risk from these ECOPCs is uncertain and will tend to underestimate the overall risk calculated, the magnitude of underestimation is likely to be low.

ESLs were not available for one of the ECOPC/receptor pairs identified in Section 7.0, antimony (birds). Therefore, the risks to birds from exposure to antimony are uncertain. However, because the risks are considered to be low for other receptors where toxicity information is available, this source of uncertainty is not expected to be significant.

10.3.3 Uncertainties Associated with Eliminating Ecological Contaminants of Interest Based on Professional Judgment

Several analytes in surface soil and subsurface soil were eliminated as ECOIs based on professional judgment. The professional judgment evaluation is intended to identify those ECOIs that have a limited potential for contamination in the IDEU. The weight-of-evidence approach indicates that there is no identified source or pattern of release in the IDEU, and the slightly elevated values of the IDEU data for these ECOIs are most likely due to natural variation. The professional judgment evaluation has little effect on the overall risk calculations because the ECOIs eliminated from further consideration are not related to site activities in the IDEU and have very low potential to be transported from historical sources to the IDEU.

10.4 Summary of Significant Sources of Uncertainty

The preceding discussion outlined the significant sources of uncertainty in the CRA process for assessing ecological risk. While some of the general sources of uncertainty discussed tend to underestimate risk, an equal or greater number of uncertainties discussed for each ECOPC and in the RI/FS Report Appendix A, Volume 2 indicate that

risk estimations may be somewhat biased toward the overestimation of risk to a generally unknown degree. The full range of the potential effects of uncertainty on the results of the ERA should be considered when reviewing the results of the risk assessment.

11.0 SUMMARY AND CONCLUSIONS

A summary of the results of this CRA for human health and ecological receptors in the IDEU is presented below.

11.1 Human Health

The COC screening analyses compared MDCs and UCLs of chemicals and radionuclides in IDEU media to PRGs for the WRW receptor. PCOCs with UCLs greater than the PRGs were statistically compared to the background concentration data set. Inorganic analytes that were statistically greater than background at the 0.1 significance level and organics with UCL concentrations greater than the PRG were carried forward to professional judgment evaluation. Based on the COC selection process, no COCs were selected for surface soil/surface sediment and subsurface soil/subsurface sediment in the IDEU and a risk characterization was not performed for the IDEU.

11.2 Ecological Risk

The overall conclusions for the ERA suggest that no significant risks to survival, growth, and reproduction are predicted for the ecological receptors evaluated in the IDEU (see Table 11.1). ECOPCs in surface soil were identified for non-PMJM receptors only. ECOPCs for selected populations of non-PMJM receptors included antimony and lead. No ECOPCs were identified in subsurface soil. The ECOPC/receptor pairs were evaluated in the risk characterization using a range of EPCs, exposure scenarios, and TRVs to give a range of risk estimates. Overall, risks to ecological receptors that may use the IDEU are considered low and are not expected to be elevated above those present in site-specific background areas.

In addition, the high species diversity and continued use of the site by numerous vertebrate species verify that habitat quality for these species remains acceptable and the ecosystem functions are being maintained (K-H 2000). Data collected on wildlife abundance and diversity indicate that wildlife populations are stable and species richness remains high during remediation activities at RFETS, including wildlife using the IDEU.

12.0 REFERENCES

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TABLES

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Table 1.1
IDEU IHSSs

IHSS	OU	PAC	Title	Description	Disposition
168	11[a]	000-168	West Spray Field	Excess water from the Solar Evaporation Ponds (IHSS 101) was sprayed in this area between April 1982 and October 1985. The ponds were used primarily for the evaporation of low-level radioactive wastes contaminated with high concentrations of nitrate.	NFA CAD/ROD - 1995
--	BZ	000-501	Roadway Spraying	Roadways in the BZ OU were sprayed with waste oils for dust suppression; reverse osmosis brine solutions and footing drain water were also applied.[b]	NFA -2005 HRR
--	BZ	NE-1400	Tear Gas Powder Release	Five pounds of CS tear gas powder spilled on the roadway in the BZ on the evening of August 5, 1987. The powder became airborne due to automotive traffic.	NFA -2005 HRR
195	16[a]	NW-195	Nickel Carbonyl Disposal	This site contains a drywell that was used to decompose approximately 185 pounds of nickel carbonyl gas between March and September 1972.	NFA OU 16 CAD/ROD - 1994

[a]IAG OU

[b]PAC 000-501 was one of 79 IHSSs/PACs proposed for NFA by the NFA Working Group in 1991. The NFA was approved in 2002 (EPA et al. 2002).

Table 1.2
Number of Samples in Each Medium by Analyte Suite

Analyte Suite	Surface Soil/Surface Sediment[a]	Subsurface Soil/Subsurface Sediment[a,b]	Surface Soil[a]	Surface Soil (PMJM)[c]	Subsurface Soil[c]
Inorganics	64	72	64	N/A	72
Organics	3	65	3	N/A	65
Radionuclides	83	70	81	1	70

[a] Used in the HHRA.

[b] Same as subsurface soil - no data for sediment greater than 0.5 ft

[c] Used in the ERA.

N/A = Not applicable.

Note: The total number of results (samples) for the analytes presented in Tables 1.3 through 1.7 may differ from the number of samples presented in Table 1.2 because not all analyses are necessarily performed for each sample.

Table 1.3
Summary of Detected Analytes in Surface Soil/Surface Sediment

Analyte	Range of Reported Detection Limits	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Inorganics (mg/kg)							
Aluminum	4.8 - 40	64	100	7,340	35,000	13,234	5,151
Antimony	0.28 - 12	64	14.1	0.330	3.50	1.39	0.923
Arsenic	0.81 - 2	64	100	4	17	7.78	1.90
Barium	0.37 - 40	64	100	62	199	124	21.8
Beryllium	0.1 - 1	64	90.6	0.500	1.90	0.664	0.226
Boron	1 - 1.2	14	78.6	4.30	9.70	5.64	2.19
Cadmium	0.064 - 1	64	42.2	0.600	1.40	0.484	0.363
Calcium	7 - 1,000	64	100	1,540	4,370	2,473	487
Chromium	0.15 - 2	64	100	9.30	26	13.7	3.83
Cobalt	0.18 - 10	64	100	3.30	11.2	6.22	1.26
Copper	0.045 - 5	64	100	5.30	88.1	13.4	9.87
Iron	1.4 - 20	64	100	9,900	23,700	13,794	2,694
Lead	0.27 - 0.6	64	100	9.50	82.9	39.9	13.3
Lithium	0.48 - 20	64	100	5.50	19.4	10.2	2.94
Magnesium	7.5 - 1,000	64	100	1,280	3,700	1,821	446
Manganese	0.17 - 3	64	100	45	558	300	78.2
Mercury	0.0069 - 0.1	64	21.9	0.00940	0.0380	0.0451	0.0141
Molybdenum	0.29 - 40	64	37.5	0.360	2.60	0.768	0.448
Nickel	0.19 - 8	64	100	5.10	32	9.86	4.50
Nitrate / Nitrite	0.1 - 0.1	50	100	2	37	13.0	11.6
Potassium	35 - 1,000	64	100	1,280	4,400	2,148	677
Selenium	0.79 - 1	64	42.2	0.400	0.680	0.385	0.134
Silica[b]	4.3 - 5	14	100	510	850	703	92.1
Silver	0.077 - 2	64	6.25	0.0850	0.600	0.207	0.118
Sodium	130 - 1,000	64	78.1	39.3	131	71.8	18.3
Strontium	0.058 - 40	64	100	14.8	41.6	22.5	4.29
Thallium	0.9 - 2	64	31.3	0.190	0.270	0.232	0.150
Tin[b]	0.84 - 40	64	21.9	2.40	4.90	1.82	1.02
Titanium[b]	0.087 - 0.1	14	100	110	340	248	67.4
Uranium[b]	1.4 - 1.6	14	7.14	2.40	2.40	0.879	0.440
Vanadium	0.46 - 10	64	100	23	71	31.1	8.20

Table 1.3
Summary of Detected Analytes in Surface Soil/Surface Sediment

Analyte	Range of Reported Detection Limits	Total Number of Results	Detection Frequency (%)[a]	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Zinc	0.45 - 4	64	100	23	70	42.7	9.12
Radionuclides (pCi/g)[c]							
Americium-241	0.006 - 0.298	62	N/A	-0.0820	0.430	0.0305	0.0593
Gross Alpha	4 - 30	8	N/A	13	79	30.1	24.0
Gross Beta	4 - 20	8	N/A	36	69	44.9	11.3
Plutonium-239/240	0.002 - 0.163	82	N/A	-0.00869	2.20	0.133	0.237
Radium-226	0.71 - 0.71	1	N/A	1.90	1.90	1.90	N/A
Uranium-233/234	0.01 - 0.388	64	N/A	0.246	15	1.96	1.81
Uranium-235	0.009 - 0.388	64	N/A	-0.0126	0.460	0.0879	0.0764
Uranium-238	0.02 - 0.282	64	N/A	0.551	13	1.96	1.56

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[b] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[c] All radionuclide values are considered detects.

N/A = Not applicable.

Table 1.4

Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment[a]

Analyte	Range of Reported Detection Limits	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum	4.6 - 40	72	98.6	1,420	52,000	10,202	8,534
Antimony	0.27 - 12	72	4.17	0.270	3.30	1.98	2.23
Arsenic	0.2 - 2	72	100	1.30	16	4.79	2.46
Barium	0.35 - 40	72	98.6	13.2	160	56.9	30.5
Beryllium	0.097 - 1	70	94.3	0.260	2.10	0.692	0.369
Calcium	3.5 - 1,000	72	98.6	195	71,900	2,521	8,415
Cesium[c]	94.4 - 200	61	14.8	1.10	6.60	5.59	8.10
Chromium	0.14 - 2	72	88.9	4.40	77.5	17.7	13.4
Cobalt	0.18 - 10	72	98.6	1	91.6	7.03	10.6
Copper	0.043 - 5	71	98.6	2.60	19.7	8.62	4.16
Iron	1.3 - 20	72	98.6	2,790	30,900	11,231	4,955
Lead	0.19 - 1.1	72	100	3.50	17.5	7.16	3.32
Lithium	0.47 - 20	72	94.4	1.60	22	5.27	3.59
Magnesium	6.7 - 1,000	72	98.6	225	5,100	1,248	914
Manganese	0.17 - 3	72	98.6	16.3	885	161	135
Mercury	0.0066 - 0.11	72	19.4	0.0470	25.4	0.413	2.99
Molybdenum	0.28 - 40	71	35.2	0.440	15.6	1.97	2.39
Nickel	0.19 - 8	72	84.7	1.40	49	11.0	7.93
Nitrate / Nitrite	0.1 - 0.1	55	90.9	0.100	2	0.519	0.553
Potassium	34 - 1,000	72	84.7	331	2,760	830	521
Selenium	0.2 - 1	70	10	0.360	0.590	0.241	0.103
Silica[c]	4.1 - 4.5	6	100	530	740	590	76.2
Silicon[c]	0 - 0	2	100	27.1	30.9	29	2.69
Silver	0.074 - 2	70	5.71	0.170	0.550	0.285	0.237
Sodium	7 - 1,000	72	91.7	19.5	965	118	152
Strontium	0.056 - 40	72	98.6	3.10	77.6	16.3	14.4
Thallium	0.29 - 2	72	5.56	0.210	0.320	0.168	0.102
Tin[c]	0.81 - 40	72	12.5	2.50	46.5	3.98	7.99
Titanium[c]	0.084 - 0.09	6	100	66	250	121	66.4
Uranium[c]	1.3 - 1.5	6	16.7	1.60	1.60	0.842	0.372

Table 1.4

Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment[a]

Analyte	Range of Reported Detection Limits	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Vanadium	0.44 - 10	72	98.6	6.10	91.9	25.0	13.7
Zinc	0.43 - 4	72	90.3	3.20	64.5	14.4	10.6
Organics (ug/kg)							
2-Butanone	10 - 113	45	2.22	4	4	5.22	0.369
Acetone	10 - 113	40	22.5	1	20	6.70	3.61
bis(2-Ethylhexyl)phthalate	10 - 330	55	41.8	36	100	124	63.1
Chloroform[c]	4.97 - 5.69	54	1.85	96	96	4.11	12.8
Diethylphthalate	10 - 330	55	3.64	190	240	175	10.2
Di-n-butylphthalate	10 - 330	55	41.8	39	520	231	111
Methylene chloride	4.97 - 5.69	52	25	1	16	3.45	3.17
Toluene	4.97 - 5.69	54	38.9	1	36	3.73	5.74
Xylene	5 - 11.3	54	1.85	5	5	2.52	0.583
Radionuclides (pCi/g)[d]							
Americium-241	0 - 0.216	63	N/A	-0.0526	0.0628	0.00653	0.0136
Cesium-134	0.02 - 0.02	2	N/A	0.0300	0.0300	0.0300	0
Cesium-137	0.02 - 0.06	4	N/A	0.0342	0.0600	0.0474	0.0146
Gross Alpha	2 - 22.18	9	N/A	8.03	31.3	16.1	8.50
Gross Beta	2.4 - 5.73	10	N/A	4.00	36.6	19.1	10.9
Plutonium-239/240	0 - 0.214	67	N/A	-0.00400	0.690	0.0227	0.0902
Radium-226	0.2 - 0.21	4	N/A	0.579	1.55	1.04	0.459
Radium-228	0.07 - 0.08	4	N/A	0.890	1.35	1.16	0.193
Strontium-89/90	0.03 - 0.7828	6	N/A	-0.0997	0.121	0.0269	0.0750
Uranium-233/234	0.012 - 0.139	67	N/A	0.444	3.20	1.39	0.521
Uranium-235	0 - 0.302	67	N/A	-0.0395	0.181	0.0660	0.0410
Uranium-238	0 - 0.16	67	N/A	0.214	3.10	1.37	0.539

[a] Same as subsurface soil - no data for sediment greater than 0.5 ft. bgs.

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] All radionuclide values are considered detects.

N/A = Not applicable.

Table 1.5
Summary of Detected Analytes in Surface Soil

Analyte	Range of Reported Detection Limits	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation
Inorganics (mg/kg)							
Aluminum	4.8 - 40	64	100	7,340	35,000	13,234	5,151
Antimony	0.28 - 12	64	14.1	0.330	3.50	1.39	0.923
Arsenic	0.81 - 2	64	100	4	17	7.78	1.90
Barium	0.37 - 40	64	100	62	199	124	21.8
Beryllium	0.1 - 1	64	90.6	0.500	1.90	0.664	0.226
Boron	1 - 1.2	14	78.6	4.30	9.70	5.64	2.19
Cadmium	0.064 - 1	64	42.2	0.600	1.40	0.484	0.363
Calcium	7 - 1,000	64	100	1,540	4,370	2,473	487
Chromium	0.15 - 2	64	100	9.30	26	13.7	3.83
Cobalt	0.18 - 10	64	100	3.30	11.2	6.22	1.26
Copper	0.045 - 5	64	100	5.30	88.1	13.4	9.87
Iron	1.4 - 20	64	100	9,900	23,700	13,794	2,694
Lead	0.27 - 0.6	64	100	9.50	82.9	39.9	13.3
Lithium	0.48 - 20	64	100	5.50	19.4	10.2	2.94
Magnesium	7.5 - 1,000	64	100	1,280	3,700	1,821	446
Manganese	0.17 - 3	64	100	45	558	300	78.2
Mercury	0.0069 - 0.1	64	21.9	0.00940	0.0380	0.0451	0.0141
Molybdenum	0.29 - 40	64	37.5	0.360	2.60	0.768	0.448
Nickel	0.19 - 8	64	100	5.10	32	9.86	4.50
Nitrate / Nitrite	0.1 - 0.1	50	100	2	37	13.0	11.6
Potassium	35 - 1,000	64	100	1,280	4,400	2,148	677
Selenium	0.79 - 1	64	42.2	0.400	0.680	0.385	0.134
Silica[b]	4.3 - 5	14	100	510	850	703	92.1
Silver	0.077 - 2	64	6.25	0.0850	0.600	0.207	0.118
Sodium	130 - 1,000	64	78.1	39.3	131	71.8	18.3
Strontium	0.058 - 40	64	100	14.8	41.6	22.5	4.29
Thallium	0.9 - 2	64	31.3	0.190	0.270	0.232	0.150
Tin[b]	0.84 - 40	64	21.9	2.40	4.90	1.82	1.02
Titanium[b]	0.087 - 0.1	14	100	110	340	248	67.4
Uranium[b]	1.4 - 1.6	14	7.14	2.40	2.40	0.879	0.440
Vanadium	0.46 - 10	64	100	23	71	31.1	8.20
Zinc	0.45 - 4	64	100	23	70	42.7	9.12
Radionuclides (pCi/g)[c]							
Americium-241	0.007 - 0.298	61	N/A	-0.0820	0.430	0.0307	0.0598
Gross Alpha	20 - 30	6	N/A	13	22	17.7	2.94
Gross Beta	20 - 20	6	N/A	36	44	39.5	3.62
Plutonium-239/240	0.002 - 0.163	81	N/A	-0.00869	2.20	0.135	0.238
Uranium-233/234	0.01 - 0.388	63	N/A	0.246	4.30	1.75	0.732
Uranium-235	0.009 - 0.388	63	N/A	-0.0126	0.300	0.0820	0.0605
Uranium-238	0.02 - 0.282	63	N/A	0.551	4.50	1.79	0.683

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[b] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[c] All radionuclide values are considered detects.

N/A = Not applicable.

Table 1.6

Summary of Detected Analytes in Surface Soil (PMJM Habitat) in the IDEU

Units	Number of Detects	Number of Samples	Detection Frequency (%)	Minimum Reported Detection Limit	Maximum Reported Detection Limit	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration	Standard Deviation[a]
Inorganics									
mg/kg	7	7	100	1.2	200	3,120	12,100	8,454.29	3,447.54
mg/kg	7	7	100	0.59	10	1.5	7.6	4.30	2.90
mg/kg	7	7	100	0.039	200	25.3	132	87.49	43.89
mg/kg	6	7	85.71429	0.031	5	0.3	0.74	0.45	0.22
mg/kg	3	3	100	0.35	0.37	1.1	5	2.57	2.12
mg/kg	2	7	28.57143	0.048	5	0.74	0.85	0.31	0.35
mg/kg	7	7	100	3.2	5,000	2,280	6,960	4,135.71	1,908.53
mg/kg	7	7	100	0.054	10	7.7	15.8	11.91	2.95
mg/kg	7	7	100	0.08	50	1.6	10.8	5.27	3.00
mg/kg	7	7	100	0.16	25	7	38	15.74	10.74
mg/kg	7	7	100	1.5	100	5,610	25,900	13,032.86	6,439.42
mg/kg	7	7	100	0.2	3	4.8	41.6	20.66	15.79
mg/kg	7	7	100	0.18	100	3.5	12.4	7.39	2.87
mg/kg	7	7	100	1.7	5,000	1240	6,490	2,691.43	1,913.33
mg/kg	7	7	100	0.033	15	96.1	556	271.59	151.52
mg/kg	3	7	42.85714	0.0012	0.2	0.003	0.0038	0.03	0.03
mg/kg	3	7	42.85714	0.13	40	0.28	0.42	0.73	0.55
mg/kg	7	7	100	0.65	40	4.5	10.7	8.17	2.14
mg/kg	3	3	100	0.1	0.1	20	26	22.67	3.06
mg/kg	7	7	100	42.5	5,000	616	4,730	1,791.86	1,391.89
mg/kg	3	7	42.85714	0.45	5	0.45	0.58	0.37	0.16
mg/kg	3	3	100	2.7	2.8	672	833	764.00	82.93
mg/kg	6	7	85.71429	104	5,000	51.4	6,510	1,589.06	2,428.55
mg/kg	7	7	100	0.0062	200	14.3	35.1	22.53	6.37
mg/kg	3	3	100	0.19	0.19	159	433	268.67	144.95
mg/kg	7	7	100	0.25	50	11.8	42	26.60	9.89
mg/kg	7	7	100	0.21	20	17.5	138	44.84	42.12
Radionuclides[c]									
pCi/g	4	4	100	0.008	0.1142	0.0044	0.025	0.02	0.01
pCi/g	4	4	100	0.004	0.0482	0.0123	0.11	0.07	0.04
pCi/g	3	3	100	0.022	0.083	1.3	2.1	1.77	0.42
pCi/g	3	3	100	0.022	0.094	0.064	0.077	0.07	0.01
pCi/g	3	3	100	0.022	0.14	1.6	2	1.80	0.20

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[b] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[c] All radionuclide values are considered detects.

Table 1.7
Summary of Detected Analytes in Subsurface Soil

Analyte	Range of Reported Detection Limits	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Inorganics (mg/kg)							
Aluminum	4.6 - 40	72	98.6	1,420	52,000	10,202	8,534
Antimony	0.27 - 12	72	4.17	0.270	3.30	1.98	2.23
Arsenic	0.2 - 2	72	100	1.30	16	4.79	2.46
Barium	0.35 - 40	72	98.6	13.2	160	56.9	30.5
Beryllium	0.097 - 1	70	94.3	0.260	2.10	0.692	0.369
Calcium	3.5 - 1,000	72	98.6	195	71,900	2,521	8,415
Cesium[b]	94.4 - 200	61	14.8	1.10	6.60	5.59	8.10
Chromium	0.14 - 2	72	88.9	4.40	77.5	17.7	13.4
Cobalt	0.18 - 10	72	98.6	1	91.6	7.03	10.6
Copper	0.043 - 5	71	98.6	2.60	19.7	8.62	4.16
Iron	1.3 - 20	72	98.6	2,790	30,900	11,231	4,955
Lead	0.19 - 1.1	72	100	3.50	17.5	7.16	3.32
Lithium	0.47 - 20	72	94.4	1.60	22	5.27	3.59
Magnesium	6.7 - 1,000	72	98.6	225	5,100	1,248	914
Manganese	0.17 - 3	72	98.6	16.3	885	161	135
Mercury	0.0066 - 0.11	72	19.4	0.0470	25.4	0.413	2.99
Molybdenum	0.28 - 40	71	35.2	0.440	15.6	1.97	2.39
Nickel	0.19 - 8	72	84.7	1.40	49	11.0	7.93
Nitrate / Nitrite	0.1 - 0.1	55	90.9	0.100	2	0.519	0.553
Potassium	34 - 1,000	72	84.7	331	2,760	830	521
Selenium	0.2 - 1	70	10	0.360	0.590	0.241	0.103
Silica[b]	4.1 - 4.5	6	100	530	740	590	76.2
Silicon[b]	0 - 0	2	100	27.1	30.9	29	2.69
Silver	0.074 - 2	70	5.71	0.170	0.550	0.285	0.237
Sodium	7 - 1,000	72	91.7	19.5	965	118	152
Strontium	0.056 - 40	72	98.6	3.10	77.6	16.3	14.4
Thallium	0.29 - 2	72	5.56	0.210	0.320	0.168	0.102
Tin[b]	0.81 - 40	72	12.5	2.50	46.5	3.98	7.99
Titanium[b]	0.084 - 0.09	6	100	66	250	121	66.4

Table 1.7
Summary of Detected Analytes in Subsurface Soil

Analyte	Range of Reported Detection Limits	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[a]	Standard Deviation[a]
Uranium[b]	1.3 - 1.5	6	16.7	1.60	1.60	0.842	0.372
Vanadium	0.44 - 10	72	98.6	6.10	91.9	25.0	13.7
Zinc	0.43 - 4	72	90.3	3.20	64.5	14.4	10.6
Organics (ug/kg)							
2-Butanone	10 - 113	45	2.22	4	4	5.22	0.369
Acetone	10 - 113	40	22.5	1	20	6.70	3.61
bis(2-Ethylhexyl)phthalate	10 - 330	55	41.8	36	100	124	63.1
Chloroform[b]	4.97 - 5.69	54	1.85	96	96	4.11	12.8
Diethylphthalate	10 - 330	55	3.64	190	240	175	10.2
Di-n-butylphthalate	10 - 330	55	41.8	39	520	231	111
Methylene chloride	4.97 - 5.69	52	25	1	16	3.45	3.17
Toluene	4.97 - 5.69	54	38.9	1	36	3.73	5.74
Xylene	5 - 11.3	54	1.85	5	5	2.52	0.583
Radionuclides (pCi/g)							
Americium-241	0 - 0.216	63	N/A	-0.0526	0.0628	0.00653	0.0136
Cesium-134	0.02 - 0.02	2	N/A	0.0300	0.0300	0.0300	0
Cesium-137	0.02 - 0.06	4	N/A	0.0342	0.0600	0.0474	0.0146
Gross Alpha	2 - 22.18	9	N/A	8.03	31.3	16.1	8.50
Gross Beta	2.4 - 5.73	10	N/A	4.00	36.6	19.1	10.9
Plutonium-239/240	0 - 0.214	67	N/A	-0.00400	0.690	0.0227	0.0902
Radium-226	0.2 - 0.21	4	N/A	0.579	1.55	1.04	0.459
Radium-228	0.07 - 0.08	4	N/A	0.890	1.35	1.16	0.193
Strontium-89/90	0.03 - 0.7828	6	N/A	-0.0997	0.121	0.0269	0.0750
Uranium-233/234	0.012 - 0.139	67	N/A	0.444	3.20	1.39	0.521
Uranium-235	0 - 0.302	67	N/A	-0.0395	0.181	0.0660	0.0410
Uranium-238	0 - 0.16	67	N/A	0.214	3.10	1.37	0.539

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[b] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[c] All radionuclide values are considered detects.

N/A = Not applicable.

Table 2.1

Essential Nutrient Screen for Surface Soil/Surface Sediment

Analyte	MDC (mg/kg)	Estimated Maximum Daily Intake[a] (mg/day)	RDA/RDI/AI[b] (mg/day)	UL[b] (mg/day)	Retain for PRG Screen?
Calcium	4,370	0.440	500-1,200	2,500	No
Magnesium	3,700	0.370	80-420	65-110	No
Potassium	4,400	0.440	2,000-3,500	N/A	No
Sodium	131	0.0130	500-2,400	N/A	No

[a] Based on the MDC and a 100 mg/day soil ingestion rate for a WRW.

[b] RDA/RDI/AI/UL taken from NAS 2000, 2002.

N/A = Not available.

Table 2.2
PRG Screen for Surface Soil/Surface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Inorganics (mg/kg)						
Aluminum	24,774	35,000	Yes	14,300	No	No
Antimony	44.4	3.50	No	--	--	No
Arsenic	**2.41**	**17**	**Yes**	**8.18**	**Yes**	**Yes**
Barium	2,872	199	No	--	--	No
Beryllium	100	1.90	No	--	--	No
Boron	9,477	9.70	No	--	--	No
Cadmium	91.4	1.40	No	--	--	No
Chromium[c]	28.4	26	No	--	--	No
Cobalt	122	11.2	No	--	--	No
Copper	4,443	88.1	No	--	--	No
Iron	33,326	23,700	No	--	--	No
Lead	1,000	82.9	No	--	--	No
Lithium	2,222	19.4	No	--	--	No
Manganese	419	558	Yes	316	No	No
Mercury	32.9	0.0380	No	--	--	No
Molybdenum	555	2.60	No	--	--	No
Nickel	2,222	32	No	--	--	No
Nitrate/Nitrite[d]	177,739	37	No	--	--	No
Selenium	555	0.680	No	--	--	No
Silica	N/A	850	UT	--	--	UT
Silver	555	0.600	No	--	--	No
Strontium	66,652	41.6	No	--	--	No
Thallium	7.78	0.270	No	--	--	No
Tin	66,652	4.90	No	--	--	No
Titanium	169,568	340	No	--	--	No
Uranium	333	2.40	No	--	--	No
Vanadium	111	71	No	--	--	No
Zinc	33,326	70	No	--	--	No
Radionuclides (pCi/g)						
Americium-241	7.69	0.430	No	--	--	No
Gross Alpha	N/A	79	UT	--	--	UT
Gross Beta	N/A	69	UT	--	--	UT
Plutonium-239/240	9.80	2.20	No	--	--	No
Radium-226	2.69	1.90	No	--	--	No
Uranium-233/234	25.3	15	No	--	--	No
Uranium-235	1.05	0.460	No	--	--	No
Uranium-238	29.3	13	No	--	--	No

[a] The value shown is equal to the most stringent of the PRGs based on a risk of 1E-06 or an HQ of 0.1.

[b] UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then the MDC is used as the

[c] The PRG for chromium (VI) is used.

[d] The PRG for nitrate is used.

N/A = Not available.

UT = Uncertain toxicity; no PRG available (assessed in Section 6.0).

Bold = Analyte retained for further consideration in the next COC selection step.

-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.

Table 2.3

Statistical Distributions and Comparison to Background for IDEU[a]

Analyte	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Data Set			IDEU Data Set					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1-p	Retain as PCOC?
Surface Soil/Surface Sediment									
Arsenic	**73**	**GAMMA**	**92**	**64**	**NONPARAMETRIC**	**100**	**WRS**	**7.00E-05**	**Yes**
Subsurface Soil/Subsurface Sediment									
Radium-228	31	GAMMA	100	4	NORMAL	100	WRS	9.60E-01	No

[a] EU data for background comparison do not include data from background locations.

Bold = Analyte retained for further consideration in the next COC selection step.

Table 2.4

Essential Nutrient Screen for Subsurface Soil/Subsurface Sediment[a]

Analyte	MDC (mg/kg)	Estimated Maximum Daily Intake[b] (mg/day)	RDA/RDI/AI[c] (mg/day)	UL[c] (mg/day)	Analyte Retained for PRG Screen?
Calcium	71,900	7.19	500-1,200	2,500	No
Magnesium	5,100	0.51	80-420	65-110	No
Potassium	2,760	0.28	2,000-3,500	N/A	No
Sodium	965	0.10	500-2,400	N/A	No

[a] Sediment greater than 0.5 ft deep was not sampled at the IDEU. Data in this table are for subsurface soil only.

[b] Based on the MDC and a 100 mg/day soil ingestion rate for a WRW.

[c] RDA/RDI/AI/UL taken from NAS 2000, 2002.

N/A = Not available.

Table 2.5

PRG Screen for Subsurface Soil/Subsurface Sediment[a]

Analyte	PRG[b]	MDC	MDC Exceeds PRG?	UCL[c]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Inorganics (mg/kg)						
Aluminum	284,902	52,000	No	--	--	No
Antimony	511	3.3	No	--	--	No
Arsenic	27.7	16	No	--	--	No
Barium	33,033	160	No	--	--	No
Beryllium	1,151	2.1	No	--	--	No
Cesium	N/A	6.6	UT	--	--	UT
Chromium[d]	327	77.5	No	--	--	No
Cobalt	1,401	91.6	No	--	--	No
Copper	51,100	19.7	No	--	--	No
Iron	383,250	30,900	No	--	--	No
Lead	1,000	17.5	No	--	--	No
Lithium	25,550	22	No	--	--	No
Manganese	4,815	885	No	--	--	No
Mercury	379	25.4	No	--	--	No
Molybdenum	6,388	15.6	No	--	--	No
Nickel	25,550	49	No	--	--	No
Nitrate/Nitrite[e]	2.04E+06	2	No	--	--	No
Selenium	6,388	0.59	No	--	--	No
Silica	N/A	740	UT	--	--	UT
Silicon	N/A	30.9	UT	--	--	UT
Silver	6,388	0.55	No	--	--	No
Strontium	766,500	77.6	No	--	--	No
Thallium	89.4	0.32	No	--	--	No
Tin	766,500	46.5	No	--	--	No
Titanium	1.95E+06	250	No	--	--	No
Uranium	3,833	1.6	No	--	--	No
Vanadium	1,278	91.9	No	--	--	No
Zinc	383,250	64.5	No	--	--	No
Organics (ug/kg)						
2-Butanone	5.33E+08	4	No	--	--	No
Acetone	1.15E+09	20	No	--	--	No
bis(2-Ethylhexyl)phthalate	2.46E+06	100	No	--	--	No

Table 2.5

PRG Screen for Subsurface Soil/Subsurface Sediment[a]

Analyte	PRG[b]	MDC	MDC Exceeds PRG?	UCL[c]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Chloroform	90,270	96	No	--	--	No
Diethylphthalate	7.37E+08	240	No	--	--	No
Di-n-butylphthalate	9.22E+07	520	No	--	--	No
Methylene Chloride	3.13E+06	16	No	--	--	No
Toluene	3.56E+07	36	No	--	--	No
Xylene	1.22E+07	5	No	--	--	No
Radionuclides (pCi/g)						
Americium-241	88.4	0.0628	No	--	--	No
Cesium-134	0.910	0.03	No	--	--	No
Cesium-137	2.54	0.06	No	--	--	No
Gross Alpha	N/A	31.3	UT	--	--	UT
Gross Beta	N/A	36.61	UT	--	--	UT
Plutonium-239/240	112	0.69	No	--	--	No
Radium-226	31	1.55	No	--	--	No
Radium-228	**1.28**	**1.35**	**Yes**	**1.38**	**Yes**	**Yes**
Strontium-89/90	152	0.121	No	--	--	No
Uranium-233/234	291	3.2	No	--	--	No
Uranium-235	12.1	0.1812	No	--	--	No
Uranium-238	337	3.1	No	--	--	No

[a] Sediment greater than 0.5 feet deep bgs was not sampled at the IDEU. Data in this table are for subsurface soil only.

[b] The value shown is equal to the most stringent of the PRGs based on a risk of 1E-06 or an HQ of 0.1.

[c] UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then the MDC is used as the UCL.

[d] The PRG for chromium (VI) is used.

[e] The PRG for nitrate is used.

N/A = Not available.

UT = Uncertain toxicity; no PRG available (assessed in Section 6.0).

Bold = Analyte retained for further consideration in the next COC selection step.

-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.

Table 2.6
Summary of the COC Selection Process

Analyte	MDC Exceeds PRG?	UCL Exceeds PRG?	Detection Frequency >5%[a]	Exceeds 30X the PRG?	Exceeds Background?	Professional Judgment - Retain?	Retain as COC?
Surface Soil/Surface Sediment							
Aluminum	Yes	No	--	--	--	--	No
Arsenic	Yes	Yes	Yes	N/A	Yes	No	No
Manganese	Yes	No	--	--	--	--	No
Subsurface Soil/Subsurface Sediment[b]							
Radium-228	Yes	Yes	N/A	N/A	No	--	No

-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.
N/A = Not applicable.

[a] All radionuclide values are considered detects.

[b] Sediment greater than 0.5 feet deep was not sampled at the IDEU. Data in this table are for subsurface soil only.

Table 6.1
Detected PCOCs without PRGs in Each Medium by Analyte Suite[a]

PCOC	Surface Soil/Surface Sediment	Subsurface Soil/Subsurface Sediment
Inorganics		
Cesium	N/A	X[b]
Silica	X[b]	X[b]
Silicon	N/A	X[b]
Radionuclides		
Gross Alpha	X	X
Gross Beta	X	X

[a] Does not include essential nutrients. Essential nutrients without PRGs were evaluated by comparing estimated intakes to recommended intakes.

[b] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

X = PRG is unavailable.

N/A = Not applicable. Analyte not detected or not analyzed.

Table 7.2

Summary of Non-PMJM NOAEL ESL Screening Results for Surface Soil in the IDEU

Analyte	Terrestrial Plant Exceedance?	Terrestrial Invertebrate Exceedance?	Terrestrial Vertebrate Exceedance?
Inorganics			
Aluminum	**Yes**	UT	UT
Antimony	No	No	**Yes**
Arsenic	**Yes**	No	**Yes**
Barium	No	No	**Yes**
Beryllium	No	No	No
Boron	**Yes**	UT	No
Cadmium	No	No	**Yes**
Calcium	UT	UT	UT
Chromium	**Yes**	**Yes**	**Yes**
Cobalt	No	UT	No
Copper	No	**Yes**	**Yes**
Iron	UT	UT	UT
Lead	No	No	**Yes**
Lithium	**Yes**	UT	No
Magnesium	UT	UT	UT
Manganese	**Yes**	UT	**Yes**
Mercury	No	No	**Yes**
Molybdenum	**Yes**	UT	**Yes**
Nickel	**Yes**	No	**Yes**
Nitrate / Nitrite	UT	UT	No
Potassium	UT	UT	UT
Selenium	No	No	No
Silicon	UT	UT	UT
Silver	No	UT	UT
Sodium	UT	UT	UT
Strontium	UT	UT	No
Thallium	No	UT	No
Tin	No	UT	**Yes**
Titanium	UT	UT	UT
Uranium	No	UT	No
Vanadium	**Yes**	UT	**Yes**
Zinc	**Yes**	No	**Yes**
Radionuclides			
Americium-241	UT	UT	No
Gross Alpha	UT	UT	UT
Gross Beta	UT	UT	UT
Plutonium-239/240	UT	UT	No
Uranium-233/234	UT	UT	No
Uranium-235	UT	UT	No
Uranium-238	UT	UT	No

UT = Uncertain toxicity; no ESL available (assessed in Section 10).

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.1

Comparison of MDCs in Surface Soil to NOAEL ESLs for Terrestrial Plants, Invertebrates, and Vertebrates in the IDEU

ECOI	MDC	Terrestrial Plants		Terrestrial Invertebrates		Mourning Dove Herbivore		Mourning Dove Insectivore		American Kestrel		Deer Mouse Herbivore		Deer Mouse Insectivore		Prairie Dog		Mule Deer		Coyote Carnivore		Coyote Generalist		Coyote Insectivore		Terrestrial Receptor		Most Sensitive Receptor	Retain for Further Analysis?
		NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	Results	
Inorganics (mg/kg)																											
Aluminum	35,000	50	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Terrestrial Plants	Yes
Antimony	3.5	5	No	78	No	N/A	N/A	N/A	N/A	N/A	N/A	9.89	No	0.905	Yes	18.7	No	57.6	No	138	No	13.2	No	3.85	No	N/A	N/A	Deer Mouse Insectivore	Yes
Arsenic	17	10	Yes	60	No	20	No	164	No	1,030	No	2.57	Yes	51.4	No	9.35	Yes	13	Yes	709	No	341	No	293	No	N/A	N/A	Deer Mouse Herbivore	Yes
Barium	199	500	No	330	No	159	Yes	357	No	1,320	No	930	No	4,430	No	3,220	No	4,770	No	24,900	No	19,800	No	18,400	No	N/A	N/A	Mourning Dove Herbivore	Yes
Beryllium	1.9	10	No	40	No	N/A	N/A	N/A	N/A	N/A	N/A	160	No	6.82	No	211	No	896	No	1,070	No	103	No	29.2	No	N/A	N/A	Deer Mouse Insectivore	No
Boron	9.7	0.5	Yes	N/A	N/A	30.3	No	115	No	167	No	62.1	No	422	No	237	No	314	No	929	No	6,070	No	1,820	No	N/A	N/A	Terrestrial Plants	Yes
Cadmium	1.4	32	No	140	No	28.1	No	0.705	Yes	15	No	59.9	No	1.56	No	198	No	723	No	1,360	No	51.2	No	9.75	No	N/A	N/A	Mourning Dove Insectivore	Yes
Calcium	4,370	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Chromium[b]	26	1	Yes	0.4	Yes	24.6	Yes	1.34	Yes	14	Yes	281	No	15.9	Yes	703	No	1,460	No	4,170	No	250	No	68.5	No	N/A	N/A	Terrestrial Invertebrates	Yes
Cobalt	11.2	13	No	N/A	N/A	278	No	87	No	440	No	1,480	No	363	No	2,460	No	7,900	No	3,780	No	2,490	No	1,520	No	N/A	N/A	Terrestrial Plants	No
Copper	88.1	100	No	50	Yes	28.9	Yes	8.25	Yes	164	No	295	No	605	No	838	No	4,120	No	5,460	No	3,000	No	4,640	No	N/A	N/A	Mourning Dove Insectivore	Yes
Iron	23,700	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Lead	82.9	110	No	1,700	No	49.9	Yes	12.1	Yes	95.8	No	1,340	No	242	No	1,850	No	9,800	No	8,930	No	3,070	No	1,390	No	N/A	N/A	Mourning Dove Insectivore	Yes
Lithium	19.4	2	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,880	No	610	No	3,180	No	10,200	No	18,400	No	5,610	No	2,560	No	N/A	N/A	Terrestrial Plants	Yes
Magnesium	3,700	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Manganese	558	500	Yes	N/A	N/A	1,030	No	2,630	No	9,920	No	486	Yes	4,080	No	1519	No	2,510	No	14,100	No	10,900	No	19,100	No	N/A	N/A	Deer Mouse Herbivore	Yes
Mercury	0.038	0.3	No	0.1	No	0.197	No	0.0001	Yes	1.57	No	0.439	No	0.179	No	3.15	No	7.56	No	8.18	No	8.49	No	37.3	No	N/A	N/A	Mourning Dove Insectivore	Yes
Molybdenum	2.6	2	Yes	N/A	N/A	44.4	No	6.97	No	76.7	No	8.68	No	1.9	Yes	27.1	No	44.3	No	275	No	28.9	No	8.18	No	N/A	N/A	Deer Mouse Insectivore	Yes
Nickel	32	30	Yes	200	No	44.1	No	1.24	Yes	13.1	Yes	16.4	Yes	0.431	Yes	38.3	No	124	No	90.9	No	6.02	Yes	1.86	Yes	N/A	N/A	Deer Mouse Insectivore	Yes
Nitrate / Nitrite	37	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4,480	No	7,650	No	16,200	No	22,700	No	32,900	No	32,200	No	32,900	No	N/A	N/A	Deer Mouse Herbivore	No
Potassium	4,400	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Selenium	0.68	1	No	70	No	1.61	No	1	No	8.48	No	0.872	No	0.754	No	2.8	No	3.82	No	32.5	No	12.2	No	5.39	No	N/A	N/A	Deer Mouse Insectivore	No
Silicon	850	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Silver	0.6	2	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Terrestrial Plants	No
Sodium	131	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Deer Mouse Herbivore	No
Strontium	41.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	940	No	13,600	No	3,520	No	4,700	No	584,000	No	145,000	No	57,300	No	N/A	N/A	Deer Mouse Herbivore	No
Thallium	0.27	1	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	180	No	7.24	No	204	No	1,040	No	212	No	81.6	No	30.8	No	N/A	N/A	Terrestrial Plants	No
Tin	4.9	50	No	N/A	N/A	26.1	No	2.9	Yes	19	No	45	No	3.77	Yes	80.6	No	242	No	70	No	36.1	No	16.2	No	N/A	N/A	Mourning Dove Insectivore	Yes
Titanium	340	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Uranium	2.4	5	No	N/A	N/A	685	No	446	No	2,790	No	970	No	569	No	1,230	No	5,470	No	7,300	No	3,110	No	2,270	No	N/A	N/A	Terrestrial Plants	No
Vanadium	71	2	Yes	N/A	N/A	503	No	274	No	1,510	No	63.7	Yes	29.9	Yes	83.5	No	358	No	341	No	164	No	121	No	N/A	N/A	Terrestrial Plants	Yes
Zinc	70	50	Yes	200	No	109	No	0.646	Yes	113	No	171	No	5.29	Yes	1,170	No	2,770	No	16,500	No	3,890	No	431	No	N/A	N/A	Mourning Dove Insectivore	Yes
Radionuclides (pCi/g)																													
Americium-241	0.43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,890	No	N/A	No
Gross Alpha	22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Gross Beta	44	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6,110	No	N/A	No
Plutonium-239/240	2.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4,980	No	N/A	No
Uranium-233/234	4.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,770	No	N/A	No
Uranium-235	0.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,580	No	N/A	No
Uranium-238	4.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A				

a Radionuclide ESLs are not receptor-specific. They are considered protective of all terrestrial ecological species.

b The ESLs for chromium were devleoped based on available toxicity data and are based on chromium III (birds) and chromium VI (plants, invertebrates and mammals).

N/A = Indicates no ESL was available for that ECOI/receptor pair.

UT = Uncertain toxicity; no ESL available (assessed in Section 10).

Bold = Analyte retained for further screening in the next ECOPC selection step.

Table 7.3
Comparison of MDCs in Surface Soil with NOAEL ESLs for the PMJM in the IDEU

Analyte	MDC	PMJM NOAEL ESL	EPC > PMJM ESL?
Inorganics (mg/kg)			
Aluminum	12,100	N/A	UT
Arsenic	**7.6**	**2.21**	**Yes**
Barium	132	743	No
Beryllium	0.74	8.16	No
Boron	5.0	52.7	No
Cadmium	0.85	1.75	No
Calcium	6,960	N/A	UT
Chromium	15.8	19.3	No
Cobalt	10.8	340	No
Copper	38.0	95.0	No
Iron	25,900	N/A	UT
Lead	41.60	220	No
Lithium	12.4	519	No
Magnesium	6,490	N/A	UT
Manganese	**556**	**388**	**Yes**
Mercury	0.0038	0.052	No
Molybdenum	0.42	1.84	No
Nickel	**10.70**	**0.51**	**Yes**
Nitrate / Nitrite	26.00	2,910	No
Potassium	4,730	N/A	UT
Selenium	**0.58**	**0.421**	**Yes**
Silica	833	N/A	UT
Sodium	6,510	N/A	UT
Strontium	35.10	833	No
Titanium	433	N/A	UT
Vanadium	**42.0**	**21.6**	**Yes**
Zinc	**138**	**6.41**	**Yes**
Organics (µg/kg)			
Benzoic acid	180	N/A	UT
Radionuclides (pCi/kg)			
Americium-241	0.025	3,890	No
Plutonium-239/240	0.11	6,110	No
Uranium-233/234	2.1	4,980	No
Uranium-235	0.077	2,770	No
Uranium-238	2.00	1,580	No

N/A = No ESL Available.

UT = Uncertain toxicity; no ESL available (assessed in Section 10).

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.4
Statistical Distribution and Comparison to Background for Surface Soil in the IDEU

Analyte	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Data Set			IDEU Data Set					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Retain as ECOI?
Inorganics (mg/kg)									
Aluminum	20	NORMAL	100	64	NONPARAMETRIC	100	WRS	4.81E-03	**Yes**
Antimony	20	NONPARAMETRIC	0	64	NONPARAMETRIC	14	N/A	N/A	**Yes[a]**
Arsenic	20	NORMAL	100	64	NONPARAMETRIC	100	WRS	7.40E-04	**Yes**
Barium	20	NORMAL	100	64	NONPARAMETRIC	100	WRS	3.65E-05	**Yes**
Boron	N/A	N/A	N/A	14	NORMAL	79	N/A	N/A	**Yes[a]**
Cadmium	20	NONPARAMETRIC	65	64	NONPARAMETRIC	42	WRS	0.959	No
Chromium	20	NORMAL	100	64	NONPARAMETRIC	100	WRS	7.62E-03	**Yes**
Copper	20	NONPARAMETRIC	100	64	NONPARAMETRIC	100	WRS	0.978	No
Lead	20	NORMAL	100	64	NONPARAMETRIC	100	WRS	1.03E-02	**Yes**
Lithium	20	NORMAL	100	64	GAMMA	100	WRS	1.88E-04	**Yes**
Manganese	20	NORMAL	100	64	NONPARAMETRIC	100	WRS	4.03E-04	**Yes**
Mercury	20	NONPARAMETRIC	40	64	NONPARAMETRIC	22	WRS	0.998	No
Molybdenum	20	NORMAL	0	64	NONPARAMETRIC	38	N/A	N/A	**Yes[a]**
Nickel	20	NORMAL	100	64	LOGNORMAL	100	WRS	0.759	No
Tin	20	NORMAL	0	64	NONPARAMETRIC	22	N/A	N/A	**Yes[a]**
Vanadium	20	NORMAL	100	64	NONPARAMETRIC	100	WRS	1.23E-01	No
Zinc	20	NORMAL	100	64	GAMMA	100	WRS	0.998	No

[a] Statistical comparisons to background cannot be performed. The analyte is retained as an ECOI for further evaluation.
N/A = Not applicable; background data not available or not detected.
WRS = Wilcoxon Rank Sum.

Table 7.5

Statistical Distributions and Comparison to Background for Surface Soil in PMJM Habitat in the IDEU

Analyte	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Data Set			IDEU Data Set					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Retain as ECOI?
Inorganics									
Arsenic	20	NORMAL	100	7	GAMMA	100	WRS	0.925	No
Manganese	20	NORMAL	100	7	NORMAL	100	t-Test N	0.203	No
Nickel	20	NORMAL	100	7	NORMAL	100	t-Test N	0.898	No
Selenium	20	NONPARAMETRIC	60	7	NORMAL	43	WRS	0.994	No
Vanadium	20	NORMAL	100	7	NORMAL	100	t-Test N	0.621	No
Zinc	20	NORMAL	100	7	LOGNORMAL	100	WRS	0.988	No

WRS = Wilcoxon Rank Sum.

t-Test_N = Student's t-test using normal data.

Table 7.6
Statistical Concentrations in Surface Soil in the IDEU

Analyte	Total Samples	UCL Recommended by ProUCL	Distribution Recommended by ProUCL	Mean	Median	75th percentile	95th percentile	UCL	UTL	MDC
Inorganics (mg/kg)										
Aluminum	64	95% Student's-t UCL	NONPARAMETRIC	13,234	11,800	15,450	19,340	14,309	19,400	35,000
Antimony	64	97.5% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	1.4	1.4	1.5	3.1	1.9	3.1	4.9
Arsenic	64	95% Student's-t UCL	NONPARAMETRIC	7.8	7.4	8.4	11.6	8.2	12	17
Barium	64	95% Student's-t UCL	NONPARAMETRIC	124	124	131	153	128	153	199
Boron	14	95% Student's-t UCL	NORMAL	5.6	5.8	6.6	9.1	6.7	10.3	9.7
Chromium	64	95% Student's-t UCL	NONPARAMETRIC	13.7	12.5	15.2	22.3	14.5	22.7	26
Lead	64	95% Student's-t UCL	NONPARAMETRIC	39.9	41.5	44.5	61.8	42.7	62.8	82.9
Lithium	64	95% Approximate Gamma UCL	GAMMA	10.2	9.5	11.7	15.8	10.8	16	19.4
Manganese	64	95% Student's-t UCL	NONPARAMETRIC	300	291	332	430	316	430	558
Molybdenum	64	95% Student's-t UCL	NONPARAMETRIC	0.8	0.7	0.8	1.5	0.9	1.5	2.6
Tin	64	95% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	1.8	1.4	2.4	4	2.4	4.1	4.9

*MDC = maximum proxy result; may be MDC or reporting limit greater than MDC.
UCL = 95% upper confidence limit on the mean, unless the MDC is less than the UCL then the MDC is used as the UCL.
UTL = 95% upper confidence limit on the 90th percentile value, unless the MDC is less than the UCL then the MDC is used as the UCL.

Table 7.7

Upper-Bound Exposure Point Concentration Comparison to Limiting tESLs in the IDEU Surface Soil

Analyte	Small Home Range Receptors			Large Home Range Receptors		
	EPC (95UTL)	Limiting ESL[a]	EPC>ESL?	EPC (95UCL)	Limiting ESL[b]	EPC>ESL?
Inorganics (mg/kg)						
Aluminum	19,400	50	**Yes**	14,309	N/A	N/A
Antimony	3.1	0.905	**Yes**	1.9	3.85	No
Arsenic	12	2.57	**Yes**	8.2	13	No
Barium	153	159	No	128	4,770	No
Boron	9.7	0.5	**Yes**	6.7	314	No
Chromium	22.7	0.4	**Yes**	14.5	68.5	No
Lead	62.8	49.9	**Yes**	42.7	1,390	No
Lithium	16	2	**Yes**	10.8	2,560	No
Manganese	430	486	No	316	2,510	No
Molybdenum	1.5	1.9	No	0.9	8.18	No
Tin	4.1	2.9	**Yes**	2.4	16.2	No

[a]Threshold ESL, if available, for the plant, invertebrate, deer mouse, prairie dog, dove, or kestrel receptors.

[b]Threshold ESL, if available, for the coyote and mule deer receptors.

N/A = Not applicable; ESL not available.

[b]Maximum = Maximum proxy result; may be MDC or reporting limit greater than MDC.

Table 7.8

Upper-Bound Exposure Point Concentration Comparison to Receptor-Specific ESLs for Small Home-Range Receptors in the IDEU Surface Soil

Analyte	Small Home Range Receptor UTL	Receptor-Specific ESLs[a]							
		Terrestrial Plant	Terrestrial Invertebrate	American Kestrel	Mourning Dove (herbivore)	Mourning Dove (insectivore)	Deer Mouse (herbivore)	Deer Mouse (insectivore)	Prairie Dog
Inorganics (mg/kg)									
Aluminum	19,400	**50**	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Antimony	3.1	5	78	N/A	N/A	N/A	9.89	**0.905**	18.7
Arsenic	12	**10**	60	1,030	20	164	**2.57**	51.4	**9.35**
Boron	10.3	**0.5**	N/A	167	30.3	115	62.1	422	237
Chromium	22.7	**1**	**0.4**	**14**	24.6	**1.34**	281	**15.9**	703
Lead	62.8	110	1700	95.8	**49.9**	**12.1**	1,340	242	1,850
Lithium	16	**2**	N/A	N/A	N/A	N/A	1,880	610	3,180
Tin	4.1	50	N/A	19	26.1	**2.9**	45	**3.77**	80.6

[a]Threshold ESL, if available, for that receptor.

N/A = Not applicable; ESL not available.

Bold = Receptors of potential concern.

Table 7.9
Summary of ECOPC Screening Steps for Surface Soil Non-PMJM Receptors in the IDEU

Analyte	Exceed Any NOAEL ESL?	Detection Frequency ≥ 5%?	Exceed Background?	Upper Bound EPC > Limiting ESL?	Professional Judgment - Retain?	ECOPC?	Receptor(s) of Potential Concern
Inorganics							
Aluminum	Yes	Yes	Yes	Yes	No	No	--
Antimony	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**Deer mouse (insectivore)**
Arsenic	Yes	Yes	Yes	Yes	No	No	--
Barium	Yes	Yes	Yes	No	--	No	--
Beryllium	No	--	--	--	--	No	--
Boron	Yes	Yes	N/A	Yes	No	No	--
Cadmium	Yes	Yes	No	--	--	No	--
Calcium	UT	--	--	--	--	No	--
Chromium	Yes	Yes	Yes	Yes	No	No	--
Cobalt	No	--	--	--	--	No	--
Copper	Yes	Yes	No	--	--	No	--
Iron	UT	--	--	--	--	No	--
Lead	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Mourning dove (herbivore)** **Mourning dove (insectivore)**
Lithium	Yes	Yes	Yes	Yes	No	No	--
Magnesium	UT	--	--	--	--	No	--
Manganese	Yes	Yes	Yes	No	--	No	--
Mercury	Yes	Yes	No	--	--	No	--
Molybdenum	Yes	Yes	N/A	No	--	No	--
Nickel	Yes	Yes	No	--	--	No	--
Nitrate / Nitrite	No	--	--	--	--	No	--
Potassium	UT	--	--	--	--	No	--
Selenium	No	--	--	--	--	No	--
Silicon	UT	--	--	--	--	No	--
Silver	No	--	--	--	--	No	--
Sodium	UT	--	--	--	--	No	--
Strontium	No	--	--	--	--	No	--
Thallium	No	--	--	--	--	No	--
Tin	Yes	Yes	N/A	Yes	No	No	--
Titanium	UT	--	--	--	--	No	--
Uranium	No	--	--	--	--	No	--
Vanadium	Yes	Yes	No	--	--	No	--
Zinc	Yes	Yes	No	--	--	No	--
Radionuclides							
Americium-241	No	--	--	--	--	No	--
Gross Alpha	UT	--	--	--	--	No	--
Gross Beta	UT	--	--	--	--	No	--
Plutonium-239/240	No	--	--	--	--	No	--
Uranium-233/234	No	--	--	--	--	No	--
Uranium-235	No	--	--	--	--	No	--
Uranium-238	No	--	--	--	--	No	--

[a] Based on results of statistical analysis at the 0.1 level of significance.

-- = Screen not performed because ECOI was eliminated from further consideration in a previous step.

UT = uncertain toxicity; ESL not available (assessed in section 10.0).

N/A = Not applicable.

Bold = Analyte retained for further consideration as an ECOPC.

Table 7.10

Summary of ECOPC Screening Steps for Surface Soil PMJM Receptors in the IDEU

Analyte	Exceed PMJM NOAEL ESL?	Exceeds Background?	Professional Judgment Retain?	ECOPC?
Inorganics				
Aluminum	UT	--	--	No
Arsenic	**Yes**	No	--	No
Barium	No	--	--	No
Beryllium	No	--	--	No
Boron	No	--	--	No
Cadmium	No	--	--	No
Calcium	UT	--	--	No
Chromium	No	--	--	No
Cobalt	No	--	--	No
Copper	No	--	--	No
Iron	UT	--	--	No
Lead	No	--	--	No
Lithium	No	--	--	No
Magnesium	UT	--	--	No
Manganese	**Yes**	No	--	No
Mercury	No	--	--	No
Molybdenum	No	--	--	No
Nickel	**Yes**	No	--	No
Nitrate / Nitrite	No	--	--	No
Potassium	UT	--	--	No
Selenium	**Yes**	No	--	No
Silica	UT	--	--	No
Sodium	UT	--	--	No
Strontium	No	--	--	No
Titanium	UT	--	--	No
Vanadium	**Yes**	No	--	No
Zinc	**Yes**	No	--	No
Organics				
Benzoic acid	UT	--	--	No
Radionuclides				
Americium-241	No	--	--	No
Plutonium-239/240	No	--	--	No
Uranium-233/234	No	--	--	No
Uranium-235	No	--	--	No
Uranium-238	No	--	--	No

-- = Screen not performed because ECOI did not pass the previous screen.

UT = Uncertain toxicity; no ESL available (assessed in Section 10).

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.11
Comparison of MDCs in Subsurface Soil to NOAEL ESLs for Burrowing Receptors in the IDEU

Analyte	MDC	Prairie Dog NOAEL ESL	MDC > ESL?
Inorganics (mg/kg)			
Aluminum	52,000	N/A	UT
Antimony	3.3	18.7	No
Arsenic	**16**	**9.35**	**Yes**
Barium	160	3,220	No
Beryllium	2.1	211	No
Calcium	71,900	N/A	UT
Cesium	6.6	N/A	UT
Chromium*	77.5	703	No
Cobalt	91.6	2,460	No
Copper	19.7	838	No
Iron	30,900	N/A	UT
Lead	17.5	1,850	No
Lithium	22	3,180	No
Magnesium	5,100	N/A	UT
Manganese	885	1,519	No
Mercury	**25.4**	**3.15**	**Yes**
Molybdenum	15.6	27.1	No
Nickel	**49**	**38.3**	**Yes**
Nitrate / Nitrite	2	16,200	No
Potassium	2,760	N/A	UT
Selenium	0.59	2.8	No
Silica	740	N/A	UT
Silicon	30.9	N/A	UT
Silver	0.55	N/A	UT
Sodium	965	N/A	UT
Strontium	77.6	3,520	No
Thallium	0.32	204	No
Tin	46.5	80.6	No
Titanium	250	N/A	UT
Uranium	1.6	1,230	No
Vanadium	**91.9**	**83.5**	**Yes**
Zinc	64.5	1,170	No
Organics (µg/kg)			
2-Butanone	4	49,400,000	No
Acetone	20	248,000	No
bis(2-ethylhexyl)phthalate	100	2,760,000	No
Chloroform	96	560,000	No
Diethylphthalate	240	221,000,000	No
Di-n-butylphthalate	520	40,600,000	No
Methylene Chloride	16	210,000	No
Toluene	36	1,220,000	No
Xylene	5	112,000	No
Radionuclides (pCi/g)			
Americium-241	0.0628	3,890	No
Cesium-134	0.03	N/A	UT
Cesium-137	0.06	20.8	No
Gross Alpha	31.3	N/A	UT
Gross Beta	36.61	N/A	UT
Plutonium-239/240	0.69	6,110	No
Radium-226	1.55	50.6	No
Radium-228	1.35	43.9	No
Strontium-89/90	0.121	22.5	No
Uranium-233/234	3.2	4,980	No
Uranium-235	0.1812	2,770	No
Uranium-238	3.1	1,580	No

* The ESL for chromium (VI) is used.

N/A = Indicates no ESL was available for that ECOI/receptor pair.

UT = Uncertain toxicity; ESL not available (assessed in Section 10.0).

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.12
Statistical Distribution and Comparison to Background for Subsurface Soil in the IDEU

Analyte	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Data Set			IDEU Data Set					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Retain as ECOI?
Inorganics (mg/kg)									
Arsenic	45	NONPARAMETRIC	93	72	GAMMA	100	WRS	0.544	No
Mercury	41	NONPARAMETRIC	29	72	NONPARAMETRIC	19.4	N/A	N/A	**Yes**[a]
Nickel	44	GAMMA	100	72	GAMMA	85	WRS	1.000	No
Vanadium	45	NORMAL	98	72	NONPARAMETRIC	99	WRS	1.000	No

[a] Statistical comparisons to background cannot be performed. The analyte is retained as an ECOI for further evaluation.

N/A = Not applicable; background data not available or not detected.

Bold = Analyte retained for further consideration in the next ECOPC selection step.

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Table 7.13

Statistical Concentrations in Subsurface Soil in the IDEU

Analyte	Units	Total Samples	UCL Recommended by ProUCL	Distribution Recommended by ProUCL	Mean	Median	75th percentile	95th percentile	UCL	UTL	MDC
Mercury	mg/kg	72	95% Chebyshev (Mean, Sd) UCL	NONPARAMETRIC	0.413	0.050	0.055	0.134	1.95	0.15	25.4

*MDC = maximum proxy result; may be MDC or reporting limit greater than MDC.

UCL = 95% upper confidence limit on the mean, unless the MDC is less than the UCL then the MDC is used as the UCL.

UTL = 95% upper confidence limit on the 90th percentile value, unless the MDC is less than the UCL then the MDC is used as the UCL.

Table 7.14
Upper-Bound Exposure Point Concentration Comparison to tESLs in the IDEU

Analyte	Burrowing Receptors		
	EPC (95UTL)	tESL[a]	EPC>ESL?
Inorganics (mg/kg)			
Mercury	0.15	3.15	No

[a]Threshold ESL (if available) for the prairie dog receptor.

Table 7.15

Summary of ECOPC Screening Steps for Subsurface Soil in the IDEU

Analyte	Exceed Any NOAEL ESL?	Detection Frequency >5%?	Exceed Background?	Upper Bound EPC > Limiting ESL?	Professional Judgment - Retain?	Retain as ECOPC?
Inorganics						
Aluminum	UT	--	--	--	--	No
Antimony	No	--	--	--	--	No
Arsenic	Yes	Yes	No	--	--	No
Barium	No	--	--	--	--	No
Beryllium	No	--	--	--	--	No
Calcium	UT	--	--	--	--	No
Cesium	UT	--	--	--	--	No
Chromium	No	--	--	--	--	No
Cobalt	No	--	--	--	--	No
Copper	No	--	--	--	--	No
Iron	UT	--	--	--	--	No
Lead	No	--	--	--	--	No
Lithium	No	--	--	--	--	No
Magnesium	UT	--	--	--	--	No
Manganese	No	--	--	--	--	No
Mercury	Yes	Yes	N/A	No	--	No
Molybdenum	No	--	--	--	--	No
Nickel	Yes	Yes	No	--	--	No
Nitrate / Nitrite	No	--	--	--	--	No
Potassium	UT	--	--	--	--	No
Selenium	No	--	--	--	--	No
Silica	UT	--	--	--	--	No
Silver	UT	--	--	--	--	No
Sodium	UT	--	--	--	--	No
Strontium	No	--	--	--	--	No
Thallium	No	--	--	--	--	No
Tin	No	--	--	--	--	No
Titanium	UT	--	--	--	--	No
Uranium	No	--	--	--	--	No
Vanadium	Yes	Yes	No	--	--	No
Zinc	No	--	--	--	--	No
Organics (µg/kg)						
2-Butanone	No	--	--	--	--	No
Acetone	No	--	--	--	--	No
bis(2-ethylhexyl)phthalate	No	--	--	--	--	No
Chloroform	No	--	--	--	--	No
Diethylphthalate	No	--	--	--	--	No
Di-n-butylphthalate	No	--	--	--	--	No
Methylene Chloride	No	--	--	--	--	No
Toluene	No	--	--	--	--	No
Xylene	No	--	--	--	--	No
Radionuclides (pCi/g)						
Americium-241	No	--	--	--	--	No
Cesium-134	UT	--	--	--	--	No
Cesium-137	No	--	--	--	--	No
Gross Alpha	UT	--	--	--	--	No
Gross Beta	UT	--	--	--	--	No
Plutonium-239/240	No	--	--	--	--	No
Radium-226	No	--	--	--	--	No
Radium-228	No	--	--	--	--	No
Strontium-89/90	No	--	--	--	--	No
Uranium-233/234	No	--	--	--	--	No
Uranium-235	No	--	--	--	--	No
Uranium-238	No	--	--	--	--	No

[a] Based on results of statistical analysis at the 0.1 level of significance.

-- = Screen not performed because ECOI did not pass the previous screen.

UT = Uncertain toxicity; ESL not available (assessed in section 10.0)

N/A = Not applicable

Table 8.1
Summary of ECOPC/Receptor Pairs

ECOPC	Receptors of Potential Concern
Surface Soil	
Antimony	Deer mouse (insectivore)
Lead	Mourning dove (herbivore) Mourning dove (insectivore)
Surface Soil - PMJM	
None	None
Subsurface Soil	
None	None

Table 8.2

Surface Soil Exposure Point Concentrations for Non-PMJM Receptors

ECOPC	Tier 1 Exposure Point Concentrations (mg/kg)		Tier 2 Exposure Point Concentrations (mg/kg)	
	95th UTL	95th UCL	95th UTL	95th UCL
Inorganics (mg/kg)				
Antimony	3.1	1.9	1.65	1.23
Lead	62.8	42.7	40.42	36.59

Table 8.3

Surface Water Exposure Point Concentrations for Non-PMJM Receptors

ECOPC	MDC	95th UTL	95th UCL	Mean
Inorganics (mg/L)				
Antimony	0.025	0.028	0.017	0.013
Lead	0.037	0.037	0.022	0.01

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Table 8.4
Receptor-Specific Exposure Parameters

Receptor	Body Weight (kg)	Body Weight Reference	Percentage of Diet			Dietary Reference	Food Ingestion Rate (kg/kg BW day^{-1})	Ingestion Rate Reference	Water Ingestion Rate (L/kg BW day^{-1})	Ingestion Rate Reference	Percentage of Diet as Soil	Soil Ingestion Reference
			Plant Tissue	Invertebrate Tissue	Bird or Mammal Tissue							
Vertebrate Receptors - Birds												
Mourning Dove (herbivore)	0.113	Average of adult values from CalEPA (2004) Online Database	100	0	0	Cowan (1952)	0.23	EPA (2003)	0.12	EPA (1993) - Estimated using model for all birds - Calder and Braun (1983)	9.3	Beyer et al. (1994) - Wild turkey used as a surrogate.
Mourning Dove (insectivore)	0.113	Average of adult values from CalEPA (2004) Online Database	0	100	0	Generalized Diet	0.23	EPA (2003)	0.12	EPA (1993) - Estimated using model for all birds - Calder and Braun (1983)	9.3	Beyer et al. (1994) - Wild turkey used as a surrogate.
Vertebrate Receptors - Mammals												
Deer Mouse (insectivore)	0.0187	Flake (1973)	0	100	0	Generalized Diet	0.065	Cronin and Bradley (1988)	0.19	Ross (1930); Dice (1922) as cited in USEPA 1993.	2	Beyer et al. (1994)

Receptor parameters for all receptors with the exception of the prairie dog and mourning dove were taken from the Watershed Risk Assessment (DOE 1996) and referenced to the original source.
All receptor parameters are estimates of central tendency except where noted.
All values are presented in a dry weight basis.

Table 8.5
Receptor Specific Intake Estimates

Intake Estimates (mg/kg BW day)						
	Plant Tissue	Invertebrate Tissue	Mammal Tissue	Soil	Surface Water	Total
Default Exposure Estimates						
Antimony						
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.124	N/A	0.002	0.005	0.211
Tier 2 UTL	N/A	0.107	N/A	0.002	0.005	0.115
Lead						
Mourning Dove - Herbivore						
Tier 1 UTL	5.01E-01	N/A	N/A	0.913	0.004	1.97
Tier 2 UTL	4.59E-01	N/A	N/A	0.783	0.004	1.35
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	3.827	N/A	0.913	0.004	6.57
Tier 2 UTL	N/A	3.378	N/A	0.783	0.004	4.53

N/A = Not applicable.

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Table 9.1
TRVs for Terrestrial Vertebrate Receptors

ECOPC	NOAEL (mg/kg day)	NOAEL Endpoint	Lowest Bounded LOAEL (mg/kg day)	LOAEL Endpoint	TRV Source	Uncertainty Factor	Final NOAEL (mg/kg day)	Threshold (mg/kg day)	Rationale For Calculation	TRV Confidence
Birds										
Lead	1.63	No change in chicken reproduction	1.94	Decrease in Japanese quail reproduction	EPA (2003)	1	1.63	N/A	No threshold value calculated because the study was not reviewed and effect levels are unknown.	Very High
Mammals										
Antimony	0.06	No change to rat progeny weight	0.59	Decrease in rat progeny weight	EPA (2003)	1	0.06	N/A	The original paper was not reviewed. Not enough information was available to calculate the threshold TRV	Very High

Threshold TRVs were independently calculated using the procedures outlined in the CRA Methodology, Section 3.1.4.

TRV Confidence:

N/A = No TRV has been identified or the TRV has been deemed unacceptable for use in ECOPC selection.

Low = TRVs that have data for only one species looking at one endpoint (non-mortality) and from one primary literature source.

Moderate = TRVs that have multiple primary literature sources looking at one endpoint (non-mortality or mortality) but with only one species evaluated.

Good = For TRVs that have either multiple species with one endpoint from multiple studies or those TRVs with multiple species and multiple endpoints from only one study.

High = For TRVs that have multiple study sources looking at multiple endpoints and more than one species.

Very High = All EcoSSLs (EPA 2003a) will be assigned this level of confidence by default.

Table 10.1

Hazard Quotient Summary For Non-PMJM Receptors

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs)	
				Based on Default TRVs	Based on Alternate TRVs (Uncertainty Analyisis)
Antimony	Deer Mouse (Insectivore)	Default	Tier 1	*NOAEL* UTL = 4 *LOAEL* UTL = 0.4	Not calculated
			Tier 2	*NOAEL* UTL = 2 *LOAEL* UTL = 0.2	Not calculated
		Alternate (Uncertainty Analysis)	Tier 1	Not calculated	Not calculated
			Tier 2	Not calculated	Not calculated
Lead	Mourning Dove (Herbivore)	Default	Tier 1	*NOAEL* UTL = 1 *LOAEL* UTL = 1	Not calculated
			Tier 2	*NOAEL* UTL = 0.8 *LOAEL* UTL = 0.7	Not calculated
		Alternate (Uncertainty Analysis)	Tier 1	Not calculated	Not calculated
			Tier 2	Not calculated	Not calculated
	Mourning Dove (Insectivore)	Default	Tier 1	*NOAEL* UTL = 4 *LOAEL* UTL = 3	Not calculated
			Tier 2	*NOAEL* UTL = 3 *LOAEL* UTL = 2	Not calculated
		Alternate (Uncertainty Analysis)	Tier 1	Not calculated	Not calculated
			Tier 2	Not calculated	Not calculated

Table 10.2
Tier 2 Grid Cell Hazard Quotients for Surface Soil in IDEU

ECOPC	Most Sensitive Receptor	Number of Grid Cells	Percent of Tier 2 Grid Means											
			NOAEL TRV				Threshold TRV				LOAEL TRV			
			HQ<1	HQ>1<5	HQ>5<10	HQ>10	HQ<1	HQ>1<5	HQ>5<10	HQ>10	HQ<1	HQ>1<5	HQ>5<10	HQ>10
Antimony	Deer Mouse - Insectivore	41	68	27	0	5	N/A	N/A	N/A	N/A	100	0	0	0
Lead	Mourning Dove - Insectivore	41	2	95	0	2	N/A	N/A	N/A	N/A	7	90	2	0

N/A = No value available.
The limiting receptor is chosen as the receptor with the lowest ESL.

Table 11.1

Summary of Risk Characterization Results for the IDEU

Analyte	Ecological Receptors	Result of Risk Characterization	Chemical-Specific Risk Description Conclusion
Surface Soil Non-PMJM Receptors			
Antimony	Terrestrial plants	Not an ECOPC.	Not an ECOPC
	Terrestrial invertebrate	Not an ECOPC.	Not an ECOPC
	American kestrel	Not an ECOPC.*	ECOPC of Uncertain Risk
	Mourning dove (herbivore)	Not an ECOPC.*	ECOPC of Uncertain Risk
	Mourning dove (insectivore)	Not an ECOPC.*	ECOPC of Uncertain Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	NOAEL HQs > 1 using default exposure scenarios. LOAEL HQs < 1 for default exposure scenarios.	Low Risk
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC
Lead	Terrestrial plants	Not an ECOPC.	Low Risk
	Terrestrial invertebrate	Not an ECOPC.	Not an ECOPC
	American kestrel	Not an ECOPC.	Not an ECOPC
	Mourning dove (herbivore)	NOAEL HQ < = 1 using default exposure scenarios LOAEL HQs < = 1 using default exposure scenarios.	Low Risk
	Mourning dove (insectivore)	NOAEL HQs > 1 using default exposure scenarios. LOAEL HQs > 1 using default exposure scenarios. Background risks similar to IDEU risks.	Low Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	Not an ECOPC.	Not an ECOPC
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC
Surface Soil PMJM Receptors			
None	Preble's meadow jumping mouse	No ECOPCs.	No ECOPCs
Subsurface Soil			
None	Prairie dog	No ECOPCs.	No ECOPCs

*ESL was not available. Analyte evaluated in Section 10.

If an ECOI was not identified as an ECOPC, no risk is predicted.

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FIGURES

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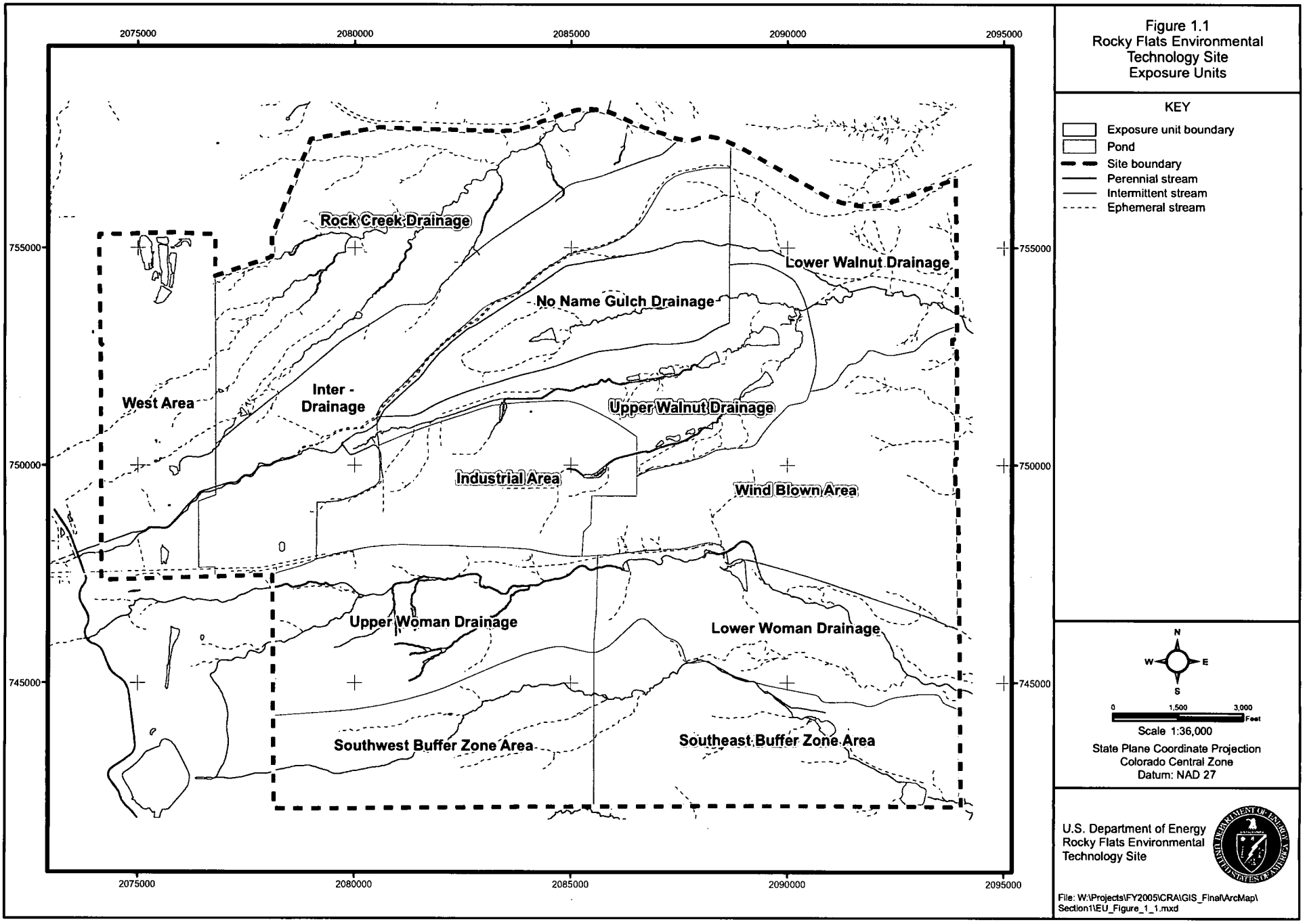

Figure 1.1
Rocky Flats Environmental Technology Site
Exposure Units

KEY

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
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0 1,500 3,000
Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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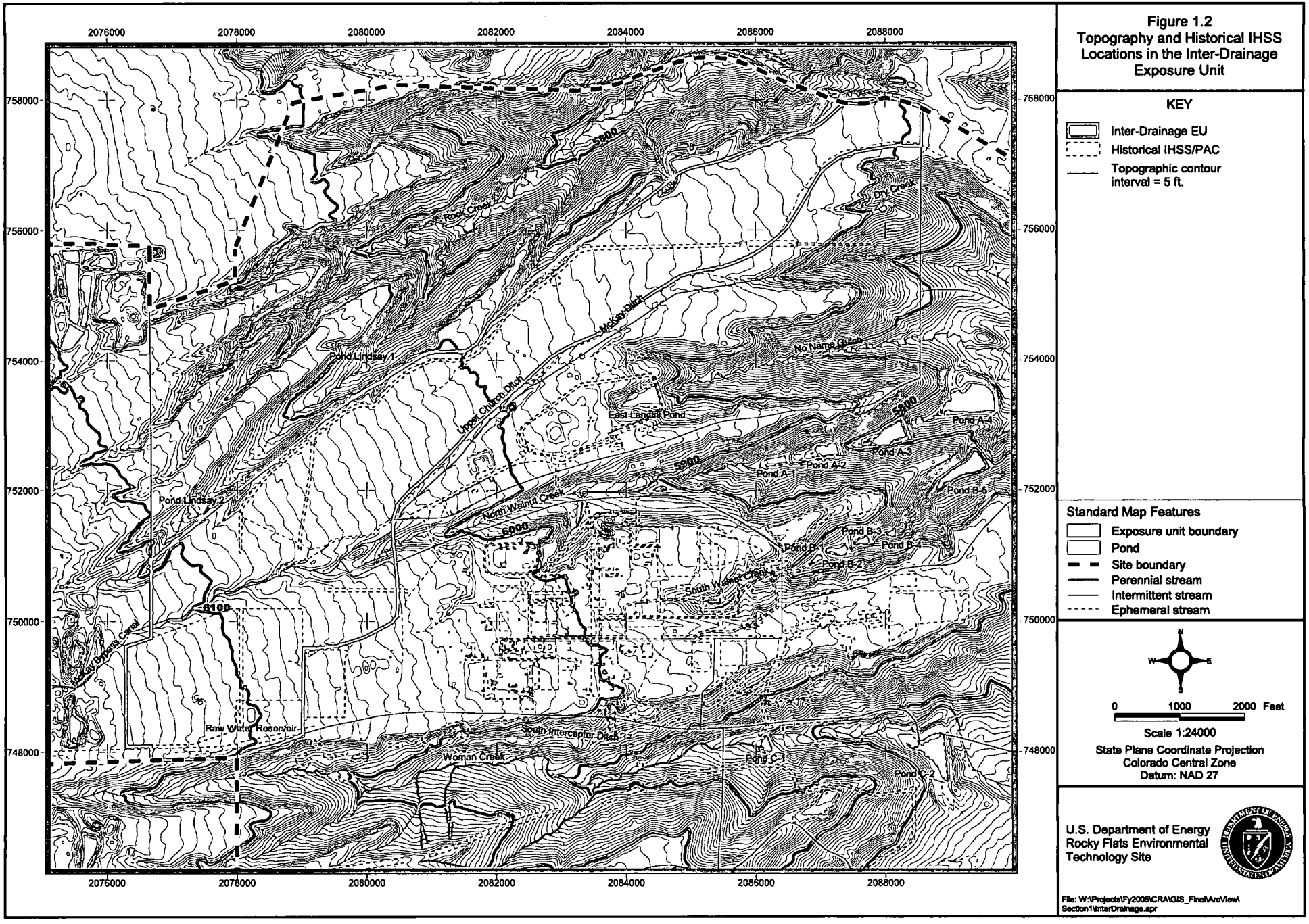

Figure 1.2
Topography and Historical IHSS Locations in the Inter-Drainage Exposure Unit

KEY

- Inter-Drainage EU
- Historical IHSS/PAC
- Topographic contour interval = 5 ft.

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
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0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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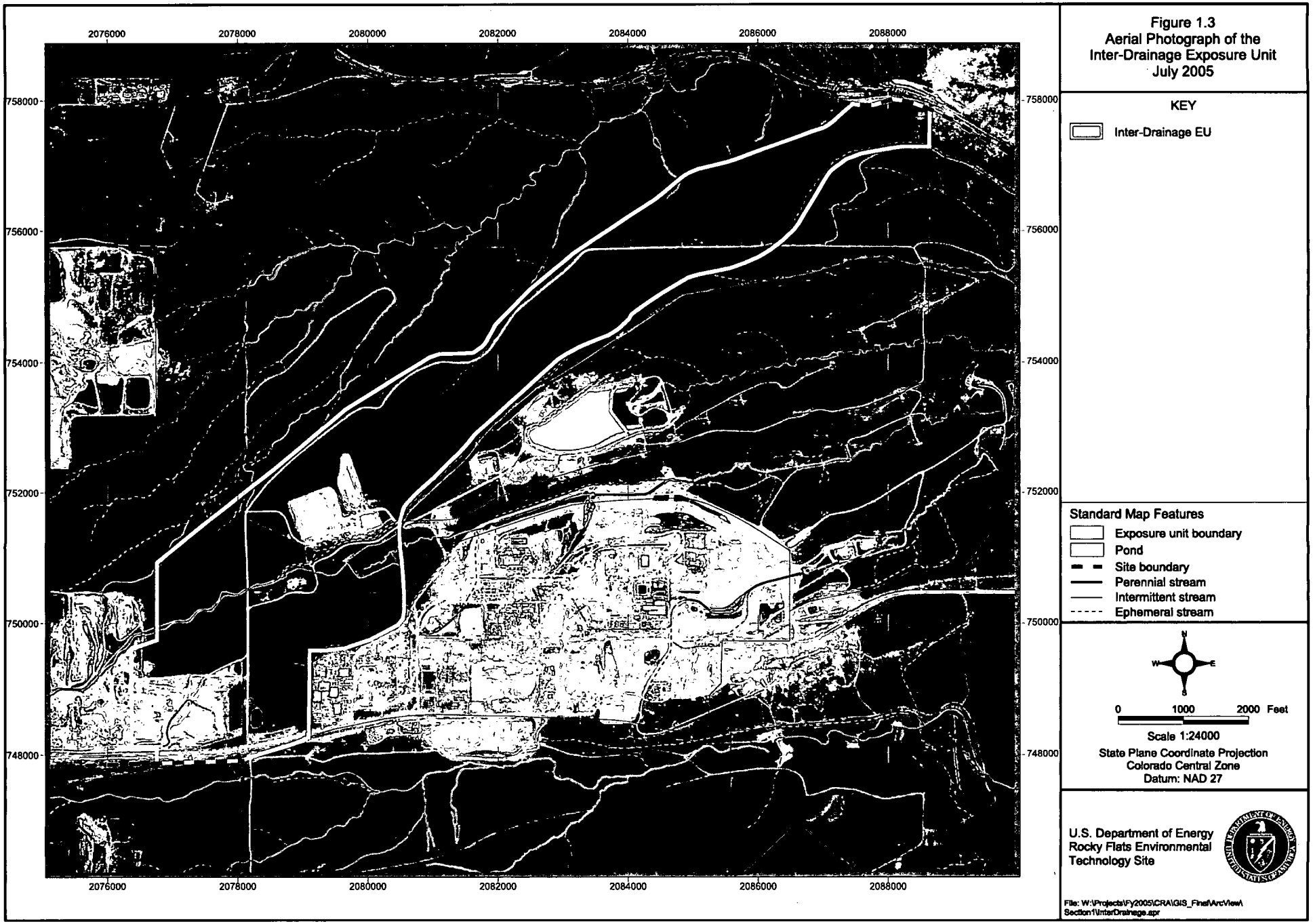
2076000
2078000
2080000
2082000
2084000
2086000
2088000
758000
756000
754000
752000
750000
748000
Figure 1.3
Aerial Photograph of the
Inter-Drainage Exposure Unit
July 2005
KEY
Inter-Drainage EU
Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream
N
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2000 Feet
Scale 1:24000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental
Technology Site
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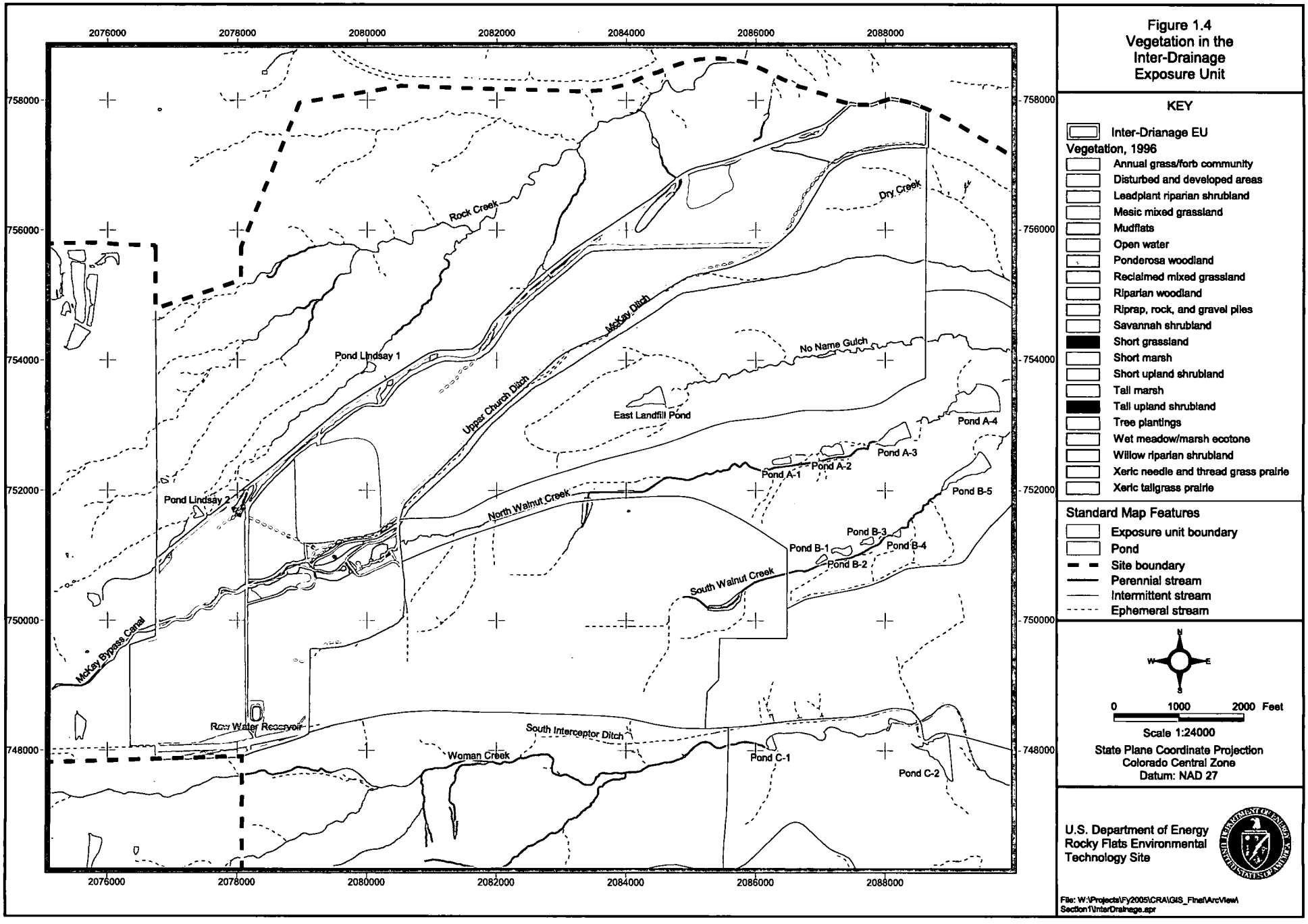

Figure 1.4
Vegetation in the
Inter-Drainage
Exposure Unit

KEY

Inter-Drianage EU

Vegetation, 1996

- Annual grass/forb community
- Disturbed and developed areas
- Leadplant riparian shrubland
- Mesic mixed grassland
- Mudflats
- Open water
- Ponderosa woodland
- Reclaimed mixed grassland
- Riparian woodland
- Riprap, rock, and gravel piles
- Savannah shrubland
- Short grassland
- Short marsh
- Short upland shrubland
- Tall marsh
- Tall upland shrubland
- Tree plantings
- Wet meadow/marsh ecotone
- Willow riparian shrubland
- Xeric needle and thread grass prairie
- Xeric tallgrass prairie

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

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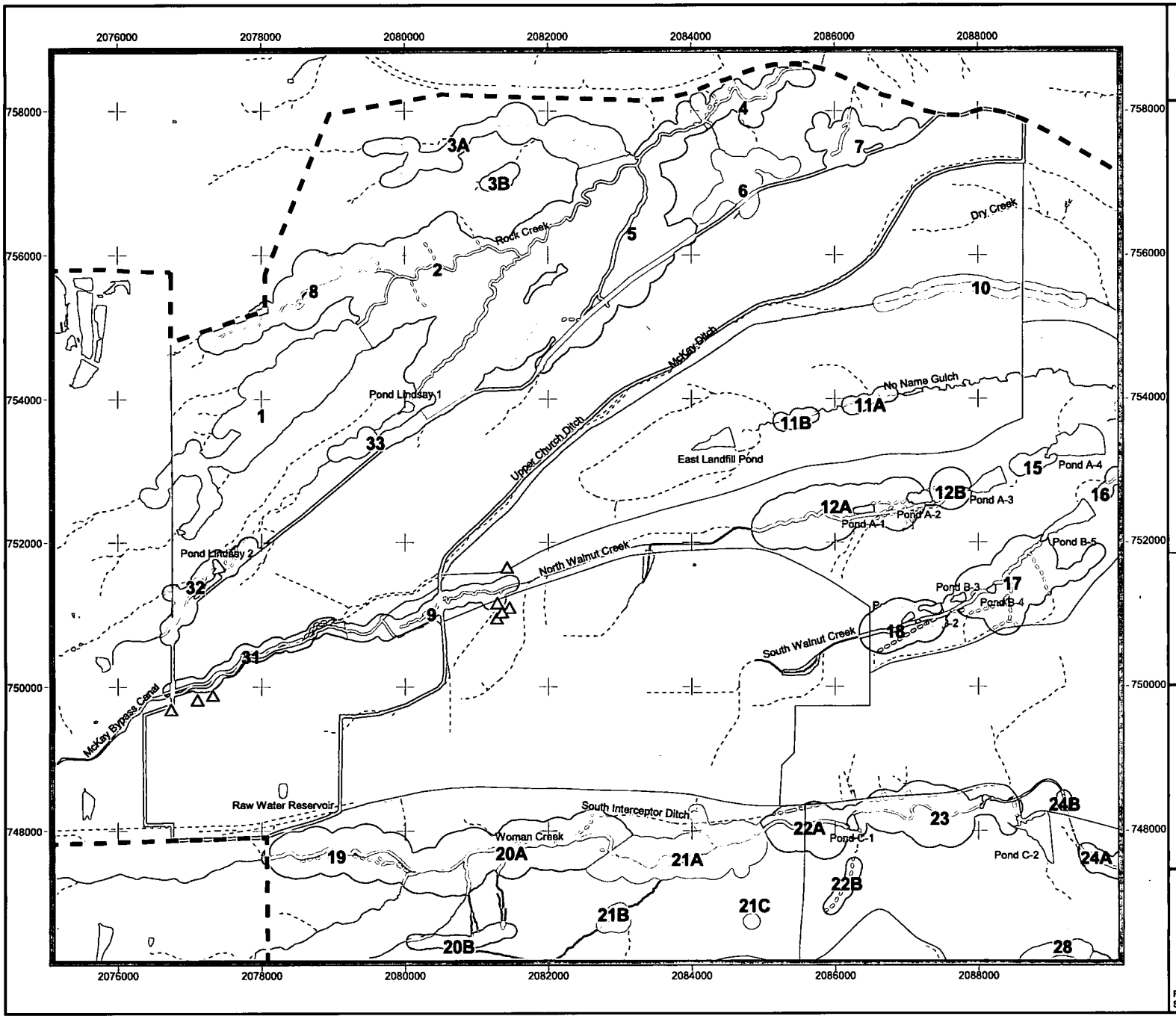

Figure 1.5
Preble's Meadow Jumping Mouse Habitat and Surface Soil Sample Locations in the Inter-Drainage Exposure Unit

KEY

- Surface soil sample location
- Inter-Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

Note: Not all analyte groups were analyzed at every sample location.

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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W E
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0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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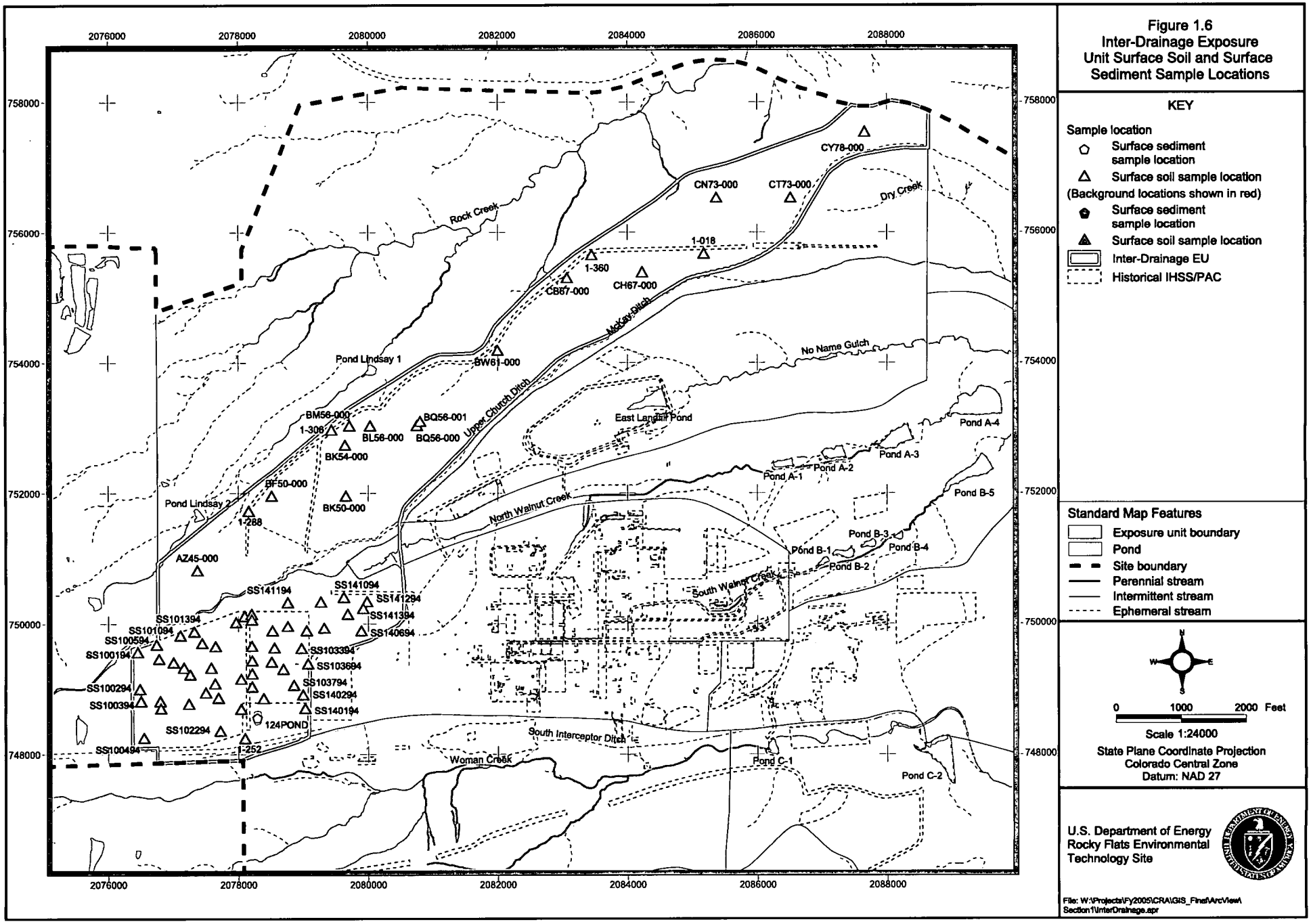

Figure 1.6
Inter-Drainage Exposure Unit Surface Soil and Surface Sediment Sample Locations

KEY

Sample location
- Surface sediment sample location
- Surface soil sample location

(Background locations shown in red)
- Surface sediment sample location
- Surface soil sample location
- Inter-Drainage EU
- Historical IHSS/PAC

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
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0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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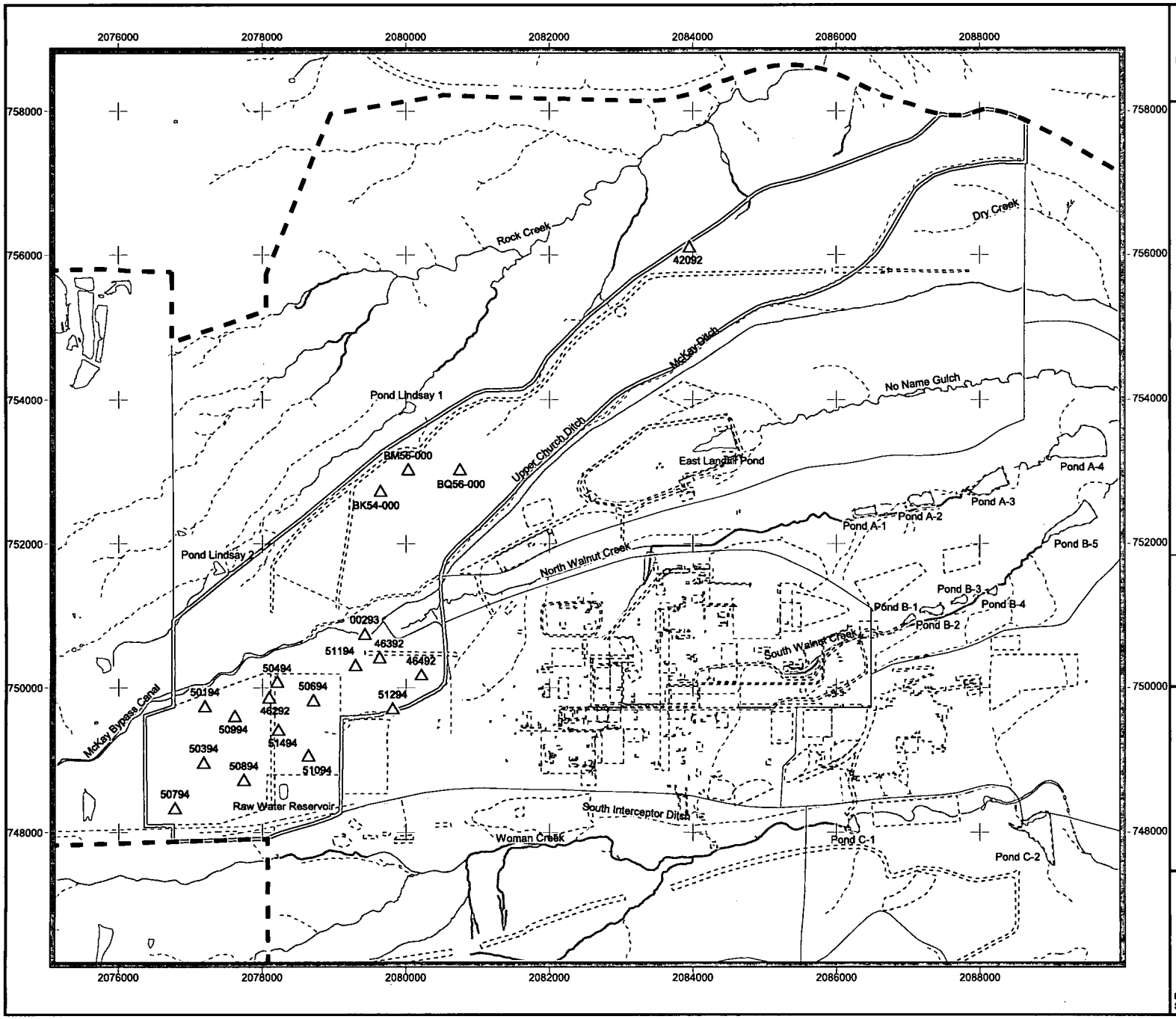

Figure 1.7
Inter-Drainage Exposure Unit Subsurface Soil and Subsurface Sediment Sample Locations

KEY

Sample location
- Subsurface sediment sample location
- Subsurface soil sample location

(Background locations shown in red)
- Subsurface sediment sample location
- Subsurface soil sample location
- Inter-Drainage EU
- Historical IHSS/PAC

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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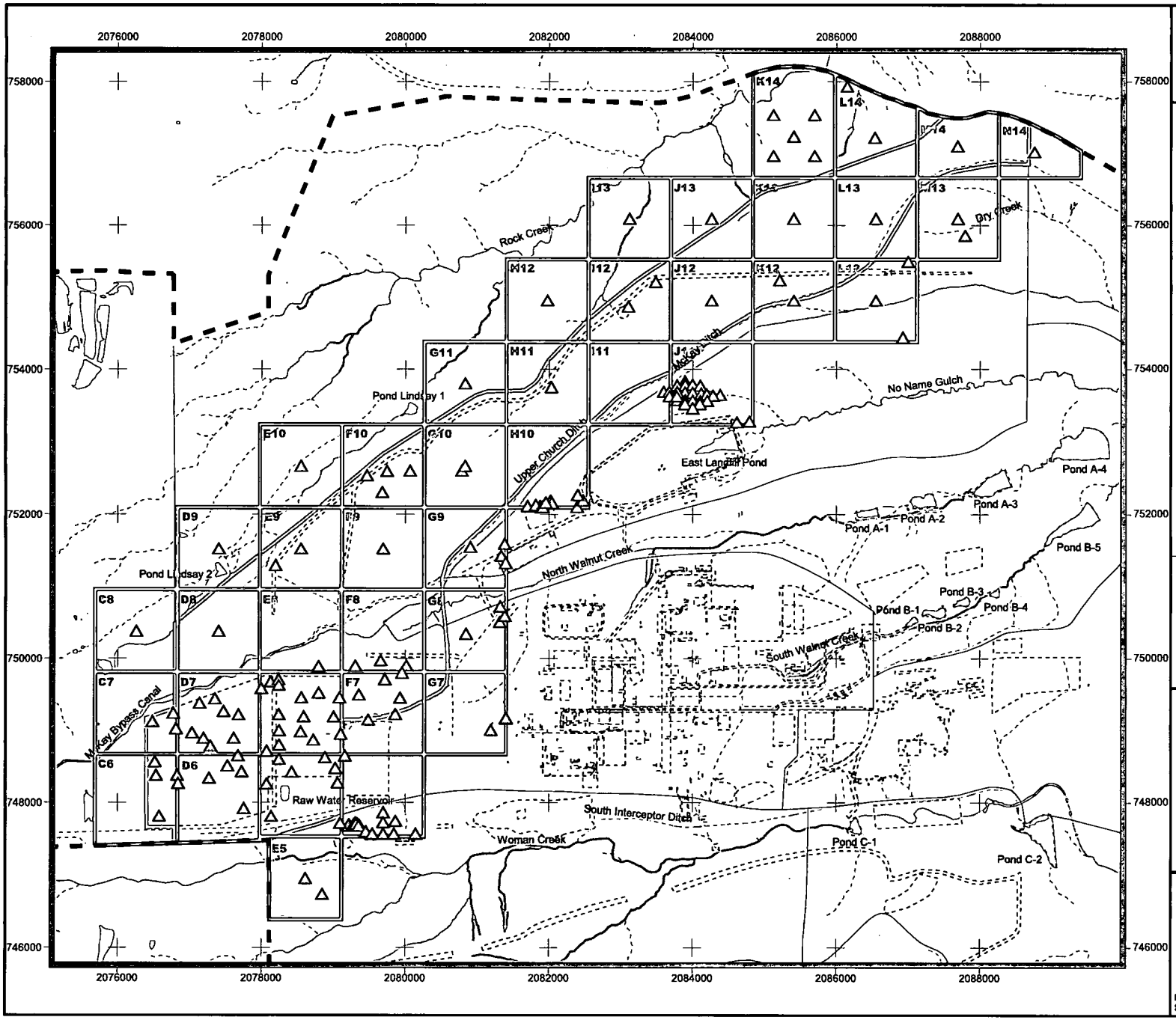

Figure 8.1
Tier 2 EPC 30-acre Grids
with Surface Soil
Sample Locations

KEY

- Surface soil sample location
- Inter-Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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W
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0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

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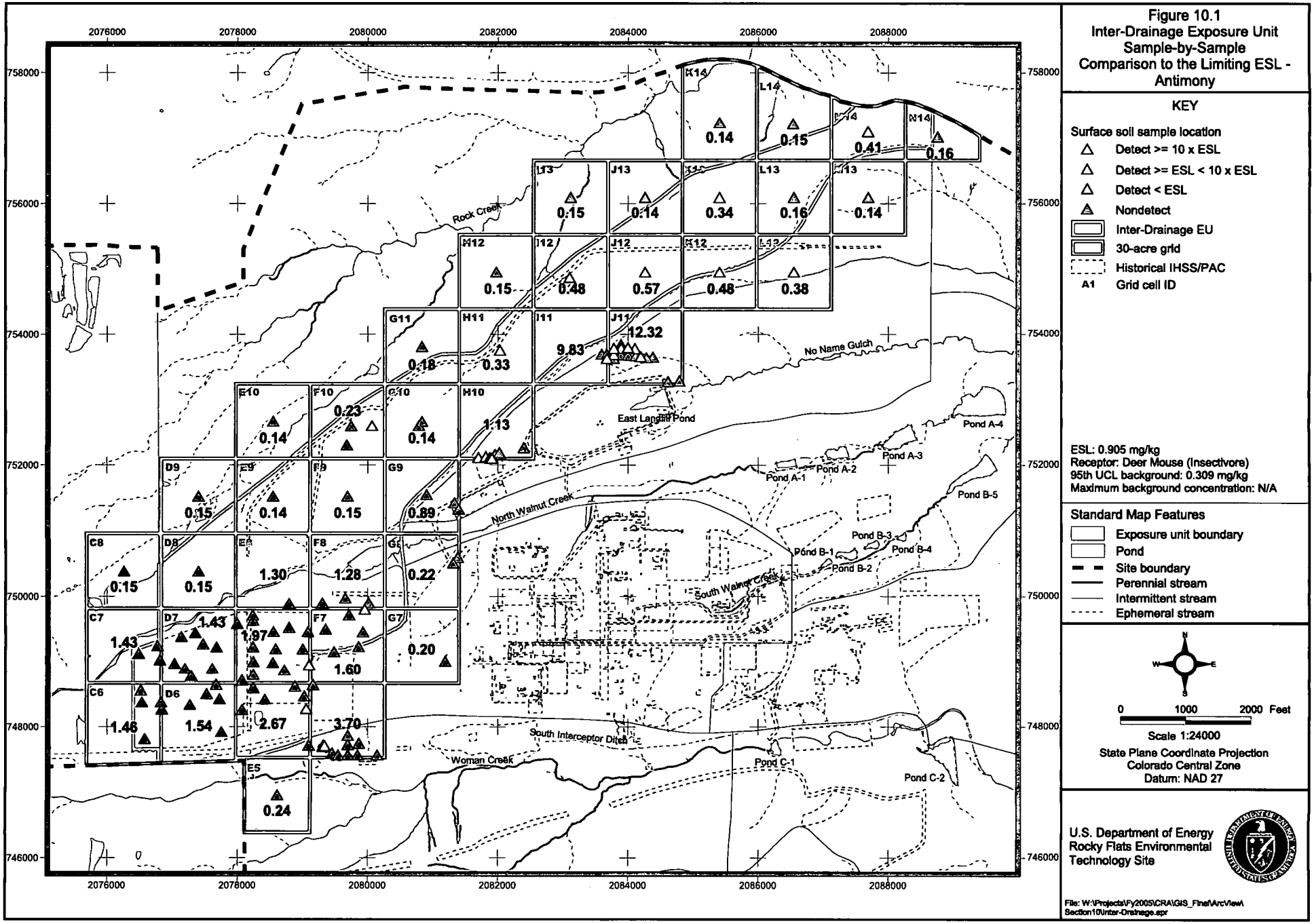

Figure 10.1
Inter-Drainage Exposure Unit
Sample-by-Sample
Comparison to the Limiting ESL -
Antimony

KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Inter-Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 0.905 mg/kg
Receptor: Deer Mouse (Insectivore)
95th UCL background: 0.309 mg/kg
Maximum background concentration: N/A

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
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0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

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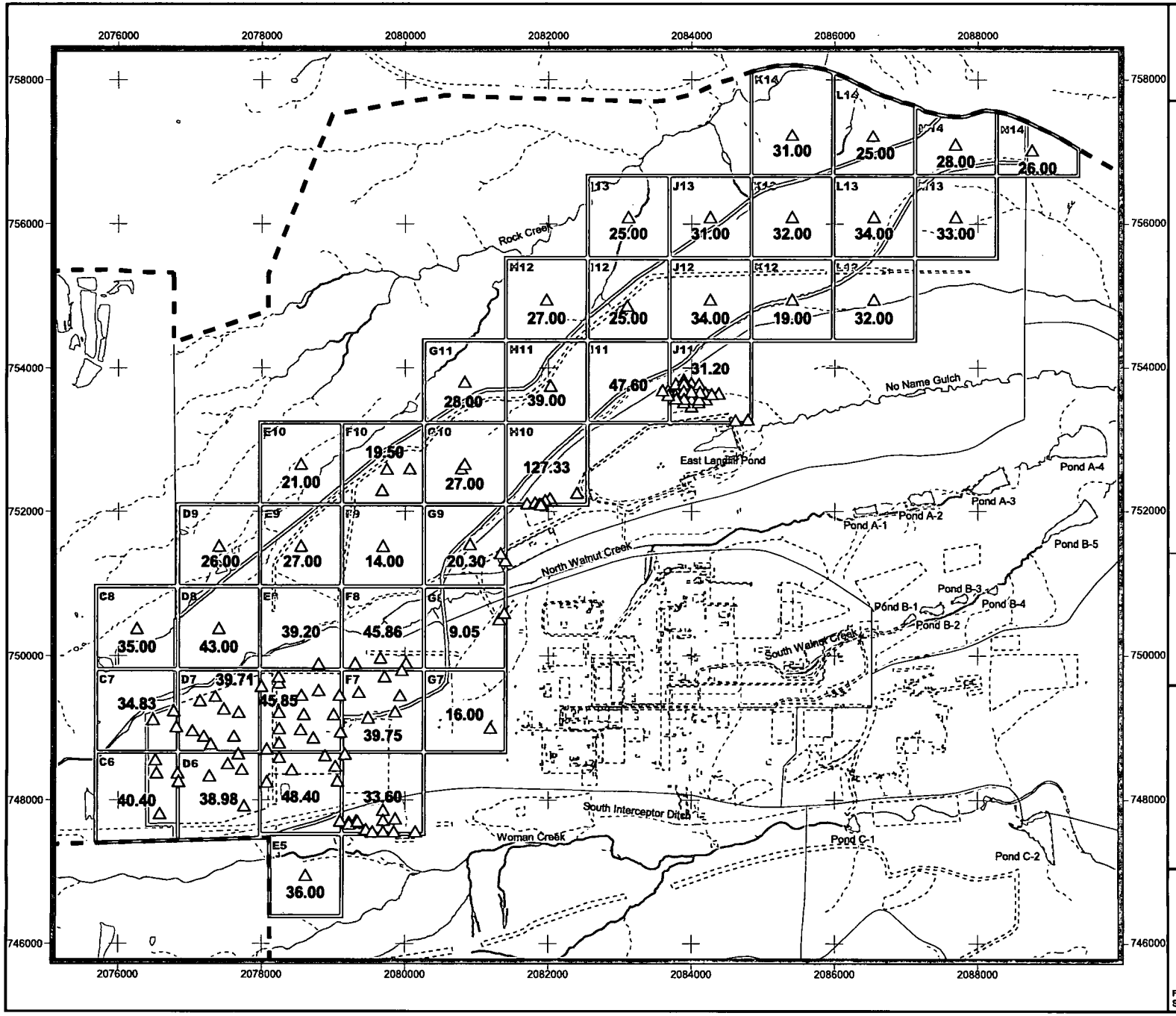

Figure 10.2
Inter-Drainage Exposure Unit
Sample-by-Sample
Comparison to the Limiting ESL -
Lead

KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Inter-Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 12.06 mg/kg
Receptor: Mourning Dove (Insectivore)
95th UCL background: 37.6 mg/kg
Maximum background concentration: 53.3 mg/kg

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 1000 2000 Feet

Scale 1:24000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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COMPREHENSIVE RISK ASSESSMENT

INTER-DRAINAGE EXPOSURE UNIT

VOLUME 5: ATTACHMENT 1

Detection Limit Screen

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ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
CD	compact disc
CRA	Comprehensive Risk Assessment
ESL	ecological screening level
IDEU	Inter-Drainage Exposure Unit
IHSS	Individual Hazardous Substance Site
mg/kg	milligrams per kilogram
N/A	not available or not applicable
NOAEL	no observed adverse effect level
PAC	Potential Area of Concern
pCi/g	picocuries per gram
PRG	preliminary remediation goal
TIC	tentatively identified compound
VOC	volatile organic compound
WRW	wildlife refuge worker

1.0 EVALUATION OF DETECTION LIMITS FOR NONDETECTED ANALYTES IN THE INTER DRAINAGE EXPOSURE UNIT

The detection limits for analytes that are either not detected or detected in less than 5 percent of the samples collected from the media used in the Human Health Risk Assessment (HHRA) or the Ecological Risk Assessment (ERA) are reviewed in this attachment. The detection limits for surface soil/surface sediment and subsurface soil/subsurface sediment samples are compared to human health preliminary remediation goals (PRGs) for the wildlife refuge worker (WRW). The detection limits for media evaluated in the ERA are compared to the minimum ecological screening level (ESL) for a variety of ecological receptors (surface soil) and the prairie dog no observed adverse effect level (NOAEL) ESL (subsurface soil). The results of these comparisons are presented in Tables A1.1 through A1.4.

Nondetects and the reported detection limits (referred to as "reported result" in the following sections of this attachment) are listed in these tables for each medium in the Inter-Drainage Exposure Unit (EU) (IDEU) and compared to medium-specific human health PRGs for the WRW and ESLs for a variety of ecological receptors. Detection limits that exceed the respective PRGs and ESLs are noted and discussed.

Analytes that were not detected in any samples collected in each media are referred to as nondetected analytes. The nondetected chemicals are reported in this attachment at the lowest level at which the chemical may be accurately and reproducibly quantified, taking into account the sample characteristics, sample collection, sample preparation, and analytical adjustments.

1.1 Comparison of Maximum Detection Limits for Nondetected Analytes to Preliminary Remediation Goals

1.1.1 Surface Soil/Surface Sediment

No nondetected analytes exceeded the PRG in surface soil/surface sediment (Table A1.1).

PRGs were not available for several nondetected inorganic and organic analytes in surface soil/surface sediment (Table A1.1). Because PRGs were available for most of the nondetected inorganics and organics in surface soil/surface sediment, and the maximum reported results for these analytes were much lower than the PRGs, the lack of PRGs for less than half of the inorganics and organics is unlikely to have a significant effect on the results of the risk assessment. In addition, the fact that no identified source exists for these analytes in the surface soil/surface sediment at the IDEU, suggests there is an acceptable level of uncertainty associated with the reported results for these nondetected analytes.

1.1.2 Subsurface Soil/Subsurface Sediment

No nondetected analytes exceeded the PRG in subsurface soil/subsurface sediment (Table A1.2).

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PRGs were not available for several nondetected organic analytes in subsurface soil/subsurface sediment (Table A1.2). Because PRGs were available for most of the nondetected organics in subsurface soil/subsurface sediment, and the maximum reported results for these analytes were much lower than the PRGs, the lack of PRGs for less than half of the organics is unlikely to have a significant effect on the results of the risk assessment. In addition, the fact that no identified source exists for these analytes in the subsurface soil/subsurface sediment at the IDEU suggests there is an acceptable level of uncertainty associated with the reported results for these nondetected analytes.

1.2 Comparison of Maximum Reported Results for Analytes Detected in Less than 5 Percent of Samples to Preliminary Remediation Goals

1.2.1 Surface Soil/Surface Sediment

There were no analytes detected in less than five percent of samples in surface soil/surface sediment in the IDEU (Table A1.1).

1.2.2 Subsurface Soil/Subsurface Sediment

No analytes detected in less than 5 percent of samples exceeded the PRG in subsurface soil/subsurface sediment in the IDEU (Table A1.2).

1.3 Comparison of Maximum Reported Results for Nondetected Analytes to Ecological Screening Levels

1.3.1 Surface Soil

No nondetected analytes exceeded the ESL in surface soil (Table A1.3).

ESLs were not available for several nondetected inorganic and organic analytes in surface soil (Table A1.3). Because ESLs were available for most of the nondetected inorganics and organics in surface soil, and the maximum reported results for these analytes were much lower than the ESLs, the lack of ESLs for less than half of the inorganics and organics is unlikely to have a significant effect on the results of the risk assessment. In addition, the fact that no identified source exists for these analytes in the surface soil at the IDEU, suggests there is an acceptable level of uncertainty associated with the reported results for these nondetected analytes.

1.3.2 Subsurface Soil

The minimum and maximum reported results for all nondetected analytes in subsurface soil were below their respective ESLs (Table A1.4).

ESLs were not available for less than half of the organics in subsurface soil (Table A1.4). Because the maximum reported results for nondetected analytes with ESLs available were much lower than the ESLs, the lack of ESLs for less than half of the organics is not likely to have a significant effect on the results of the risk assessment.

1.4 Comparison of Maximum Reported Results for Analytes Detected in Less than 5 Percent of Samples to Ecological Screening Levels

1.4.1 Surface Soil

There were no analytes detected in less than 5 percent of samples in surface soil in the IDEU (Table A1.3).

1.4.2 Subsurface Soil

The maximum reported result for one analyte detected in less than 5 percent of samples exceeded the ESL in subsurface soil (Table A1.4). Therefore, there is some uncertainty associated with the reported results for analytes detected in less than 5 percent of samples in subsurface soil in the IDEU.

The maximum reported result for one sample was greater than the ESL for antimony. This sample was taken at sample location 46392.

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TABLES

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Table A1.1

Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil/Surface Sediment[a]

Analyte	Range of Reported Results	Total Number of Results	PRG	Maximum Reported Result > PRG?[b]
Inorganics (mg/kg)				
Cesium	8.3 - 15.8	50	N/A	UT
Cyanide	2.5 - 4.7	50	2,222	No
Organics (ug/kg)				
1,1,1,2-Tetrachloroethane	1.281 - 1.333	3	91,018	No
1,1,1-Trichloroethane	1.137 - 1.183	3	9.18E+06	No
1,1,2,2-Tetrachloroethane	1.177 - 1.224	3	10,483	No
1,1,2-Trichloro-1,2,2-trifluoroethane	1.935 - 2.012	3	2.38E+09	No
1,1,2-Trichloroethane	0.963 - 1.001	3	28,022	No
1,1-Dichloroethane	1.021 - 1.063	3	2.72E+06	No
1,1-Dichloroethene	1.535 - 1.597	3	17,366	No
1,1-Dichloropropene	1.304 - 1.356	3	N/A	UT
1,2,3-Trichlorobenzene	1.476 - 1.536	3	N/A	UT
1,2,3-Trichloropropane	1.074 - 1.117	3	2,079	No
1,2,4-Trichlorobenzene	1.488 - 1.548	3	151,360	No
1,2,4-Trimethylbenzene	1.056 - 1.098	3	132,620	No
1,2-Dibromo-3-chloropropane	2.76 - 2.87	3	2,968	No
1,2-Dibromoethane	1.155 - 1.201	3	35.1	No
1,2-Dichlorobenzene	1.329 - 1.383	3	2.89E+06	No
1,2-Dichloroethane	1.165 - 1.212	3	13,270	No
1,2-Dichloropropane	0.942 - 0.98	3	38,427	No
1,3,5-Trimethylbenzene	0.731 - 0.76	3	114,340	No
1,3-Dichlorobenzene	1.464 - 1.522	3	3.33E+06	No
1,3-Dichloropropane	0.817 - 0.85	3	N/A	UT
1,4-Dichlorobenzene	1.148 - 1.194	3	91,315	No
2,2-Dichloropropane	1.079 - 1.122	3	N/A	UT
2-Butanone	10.34 - 10.75	3	4.64E+07	No
2-Chlorotoluene	1.635 - 1.701	3	2.22E+06	No
2-Hexanone	8.279 - 8.612	3	N/A	UT
4-Chlorotoluene	0.959 - 0.997	3	N/A	UT
4-Isopropyltoluene	1.207 - 1.256	3	N/A	UT
4-Methyl-2-pentanone	6.999 - 7.28	3	8.32E+07	No
Acetone	24.03 - 25.01	3	1.00E+08	No
Benzene	0.888 - 0.923	3	23,563	No
Bromobenzene	1.347 - 1.4	3	N/A	UT
Bromochloromethane	1.291 - 1.343	3	N/A	UT
Bromodichloromethane	0.709 - 0.737	3	67,070	No
Bromoform	1.149 - 1.196	3	419,858	No
Bromomethane	1.651 - 1.717	3	20,959	No
Carbon Disulfide	2.858 - 2.973	3	1.64E+06	No
Carbon Tetrachloride	1.215 - 1.263	3	8,446	No
Chlorobenzene	1.022 - 1.064	3	666,523	No
Chloroethane	4.024 - 4.185	3	1.43E+06	No
Chloroform	0.926 - 0.963	3	7,850	No
Chloromethane	1.444 - 1.502	3	115,077	No

Table A1.1

Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil/Surface Sediment[a]

Analyte	Range of Reported Results	Total Number of Results	PRG	Maximum Reported Result > PRG?[b]
cis-1,2-Dichloroethene	1.293 - 1.345	3	1.11E+06	No
cis-1,3-Dichloropropene	0.902 - 0.938	3	19,432	No
Dibromochloromethane	1.034 - 1.075	3	49,504	No
Dibromomethane	1.137 - 1.183	3	N/A	UT
Ethylbenzene	0.893 - 0.929	3	5.39E+06	No
Hexachlorobutadiene	1.568 - 1.63	3	22,217	No
Isopropylbenzene	1.337 - 1.39	3	32,680	No
Methylene Chloride	1.336 - 1.39	3	271,792	No
Naphthalene	1.392 - 1.448	3	1.40E+06	No
n-Butylbenzene	1.066 - 1.109	3	N/A	UT
n-Propylbenzene	1.187 - 1.234	3	N/A	UT
sec-Butylbenzene	1.124 - 1.17	3	N/A	UT
Styrene	1.079 - 1.122	3	1.38E+07	No
tert-Butylbenzene	1.175 - 1.222	3	N/A	UT
Tetrachloroethene	1.408 - 1.463	3	6,705	No
Toluene	1.355 - 1.41	3	3.09E+06	No
trans-1,2-Dichloroethene	1.437 - 1.495	3	287,340	No
trans-1,3-Dichloropropene	1.011 - 1.052	3	20,820	No
Trichloroethene	0.765 - 0.796	3	1,770	No
Trichlorofluoromethane	1.344 - 1.398	3	1.51E+06	No
Vinyl Chloride	3.031 - 3.153	3	2,169	No
Xylene[c]	2.693 - 2.801	3	1.06E+06	No

[a] No analytes detected in less than 5 percent of samples.

[b] Value is the maximum reported result for nondetected analytes.

[c] The value for total xylene is used.

N/A = Not Available.

UT = Uncertain toxicity.

Table A1.2

Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil/Subsurface Sediment[a]

Analyte	Range of Reported Results	Total Number of Results	PRG	Maximum Reported Result > PRG?[b]
Inorganics (mg/kg)				
Antimony[c]	0.27 - 33.8	72	511	No
Boron	1 - 4.6	6	108,980	No
Cadmium	0.062 - 3	69	1,051	No
Cyanide	2.5 - 2.8	55	25,550	No
Organics (µg/kg)				
1,1,1,2-Tetrachloroethane	1.178 - 1.347	6	1.05E+06	No
1,1,1-Trichloroethane	1.044 - 7	53	1.06E+08	No
1,1,2,2-Tetrachloroethane	1.081 - 7	54	120,551	No
1,1,2-Trichloro-1,2,2-trifluoroethane	1.778 - 2.032	6	2.74E+10	No
1,1,2-Trichloroethane	0.885 - 7	53	322,253	No
1,1-Dichloroethane	0.938 - 7	53	3.12E+07	No
1,1-Dichloroethene	1.411 - 7	53	199,706	No
1,1-Dichloropropene	1.197 - 1.37	6	N/A	UT
1,2,3-Trichlorobenzene	1.357 - 1.551	6	N/A	UT
1,2,3-Trichloropropane	0.987 - 1.129	6	23,910	No
1,2,4-Trichlorobenzene	1.368 - 370	61	1.74E+06	No
1,2,4-Trimethylbenzene	0.97 - 1.109	6	1.53E+06	No
1,2-Dibromo-3-chloropropane	2.535 - 2.899	6	34,137	No
1,2-Dibromoethane	1.061 - 1.213	6	403	No
1,2-Dichlorobenzene	1.221 - 370	61	3.32E+07	No
1,2-Dichloroethane	1.07 - 7	53	152,603	No
1,2-Dichloroethene	5 - 7	47	1.15E+07	No
1,2-Dichloropropane	0.865 - 7	53	441,907	No
1,3,5-Trimethylbenzene	0.671 - 0.768	6	1.31E+06	No
1,3-Dichlorobenzene	1.345 - 370	61	3.83E+07	No
1,3-Dichloropropane	0.751 - 0.859	6	N/A	UT
1,4-Dichlorobenzene	1.055 - 370	61	1.05E+06	No
2,2-Dichloropropane	0.992 - 1.134	6	N/A	UT
2,4,5-Trichlorophenol	1,700 - 1,900	55	9.22E+07	No
2,4,6-Trichlorophenol	330 - 370	55	3.13E+06	No
2,4-Dichlorophenol	330 - 370	55	2.76E+06	No
2,4-Dimethylphenol	330 - 370	55	1.84E+07	No
2,4-Dinitrophenol	1,700 - 1,900	45	1.84E+06	No
2,4-Dinitrotoluene	330 - 370	55	1.84E+06	No
2,6-Dinitrotoluene	330 - 370	55	921,651	No
2-Butanone[c]	9.5 - 13	44	5.33E+08	No
2-Chloronaphthalene	330 - 370	55	7.37E+07	No
2-Chlorophenol	330 - 370	55	6.39E+06	No
2-Chlorotoluene	1.503 - 1.719	6	2.56E+07	No
2-Hexanone	7.609 - 13	46	N/A	UT
2-Methylnaphthalene	330 - 370	55	3.69E+06	No
2-Methylphenol	330 - 370	52	4.61E+07	No
2-Nitroaniline	1,700 - 1,900	55	2.21E+06	No
2-Nitrophenol	330 - 370	55	N/A	UT

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Table A1.2

Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil/Subsurface Sediment[a]

Analyte	Range of Reported Results	Total Number of Results	PRG	Maximum Reported Result >PRG?[b]
3,3'-Dichlorobenzidine	660 - 740	52	76,667	No
3-Nitroaniline	1,700 - 1,900	46	N/A	UT
4,6-Dinitro-2-methylphenol	1,700 - 1,900	54	92,165	No
4-Bromophenyl-phenylether	330 - 370	55	N/A	UT
4-Chloro-3-methylphenol	330 - 370	55	N/A	UT
4-Chloroaniline	330 - 370	52	3.69E+06	No
4-Chlorophenyl-phenyl ether	330 - 370	55	N/A	UT
4-Chlorotoluene	0.881 - 1.008	6	N/A	UT
4-Isopropyltoluene	1.109 - 1.268	6	N/A	UT
4-Methyl-2-pentanone	6.431 - 13	46	9.57E+08	No
4-Methylphenol	330 - 370	55	4.61E+06	No
4-Nitroaniline	1,700 - 1,900	55	2.39E+06	No
4-Nitrophenol	1,700 - 1,900	55	7.37E+06	No
Acenaphthene	330 - 370	55	5.10E+07	No
Acenaphthylene	330 - 370	55	N/A	UT
Anthracene	330 - 370	55	2.55E+08	No
Benzene	0.816 - 7	53	270,977	No
Benzo(a)anthracene	330 - 370	55	43,616	No
Benzo(a)pyrene	330 - 370	55	4,357	No
Benzo(b)fluoranthene	330 - 370	55	43,616	No
Benzo(g,h,i)perylene	330 - 370	55	N/A	UT
Benzo(k)fluoranthene	330 - 370	55	436,159	No
Benzoic Acid	1,700 - 1,900	52	3.69E+09	No
Benzyl Alcohol	330 - 370	52	2.76E+08	No
bis(2-Chloroethoxy) methane	330 - 370	55	N/A	UT
bis(2-Chloroethyl) ether	330 - 370	55	43,315	No
bis(2-Chloroisopropyl) ether	330 - 370	55	681,967	No
Bromobenzene	1.238 - 1.415	6	N/A	UT
Bromochloromethane	1.186 - 1.356	6	N/A	UT
Bromodichloromethane	0.651 - 7	53	771,304	No
Bromoform	1.056 - 7	54	4.83E+06	No
Bromomethane	1.517 - 13	53	241,033	No
Butylbenzylphthalate	330 - 370	55	1.84E+08	No
Carbon Disulfide	2.627 - 7	49	1.88E+07	No
Carbon Tetrachloride	1.116 - 7	53	97,124	No
Chlorobenzene	0.939 - 7	54	7.67E+06	No
Chloroethane	3.697 - 13	53	1.65E+07	No
Chloroform[c]	0.85 - 7	53	90,270	No
Chloromethane	1.327 - 13	53	1.32E+06	No
Chrysene	330 - 370	55	4.36E+06	No
cis-1,2-Dichloroethene	1.188 - 1.359	6	1.28E+07	No
cis-1,3-Dichloropropene	0.829 - 7	53	223,462	No
Dibenz(a,h)anthracene	330 - 370	55	4,362	No
Dibenzofuran	330 - 370	55	2.56E+06	No
Dibromochloromethane	0.95 - 7	53	569,296	No

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Table A1.2

Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil/Subsurface Sediment[a]

Analyte	Range of Reported Results	Total Number of Results	PRG	Maximum Reported Result >PRG?[b]
Dibromomethane	1.045 - 1.195	6	N/A	UT
Diethylphthalate[c]	330 - 370	53	7.37E+08	No
Dimethylphthalate	330 - 370	55	9.22E+09	No
Di-n-octylphthalate	330 - 370	55	3.69E+07	No
Ethylbenzene	0.821 - 7	54	6.19E+07	No
Fluoranthene	330 - 370	55	3.40E+07	No
Fluorene	330 - 370	55	3.69E+07	No
Hexachlorobenzene	330 - 370	55	21,508	No
Hexachlorobutadiene	1.441 - 370	61	255,500	No
Hexachlorocyclopentadiene	330 - 370	45	4.38E+06	No
Hexachloroethane	330 - 370	55	1.28E+06	No
Indeno(1,2,3-cd)pyrene	330 - 370	55	43,616	No
Isophorone	330 - 370	55	3.63E+07	No
Isopropylbenzene	1.229 - 1.404	6	375,823	No
Naphthalene	1.28 - 370	61	1.61E+07	No
n-Butylbenzene	0.98 - 1.12	6	N/A	UT
Nitrobenzene	330 - 370	55	497,333	No
N-Nitroso-di-n-propylamine	330 - 370	55	4,929	No
N-nitrosodiphenylamine	330 - 370	55	7.04E+06	No
n-Propylbenzene	1.09 - 1.246	6	N/A	UT
Pentachlorophenol	1,700 - 1,900	55	202,777	No
Phenanthrene	330 - 370	55	N/A	UT
Phenol	330 - 370	55	2.76E+08	No
Pyrene	330 - 370	55	2.55E+07	No
sec-Butylbenzene	1.033 - 1.182	6	N/A	UT
Styrene	0.992 - 7	54	1.59E+08	No
tert-Butylbenzene	1.08 - 1.235	6	N/A	UT
Tetrachloroethene	1.293 - 7	54	77,111	No
trans-1,2-Dichloroethene	1.32 - 1.51	6	3.30E+06	No
trans-1,3-Dichloropropene	0.929 - 7	54	239,434	No
Trichloroethene	0.703 - 7	53	20,354	No
Trichlorofluoromethane	1.235 - 1.413	6	1.74E+07	No
Vinyl acetate	10 - 13	47	3.04E+07	No
Vinyl Chloride	2.786 - 13	53	24,948	No
Xylene[c,d]	2.475 - 7	53	1.22E+07	No

[a] No sediment data greater than 0.5 ft deep are available for the IDEU. The data summary in this table consists of subsurface soil data only.

[b] Value is the maximum reported result for nondetected analytes.

[c] Analyte has a detection frequency of less than 5 percent.

[d] The value for total xylene is used.

N/A = Not Available.

UT = Uncertain toxicity.

Table A1.3
Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil[a]

Analyte	Range of Reported Results	Total Number of Results	Lowest ESL	Maximum Reported Result >ESL?[b]
Inorganics (mg/kg)				
Cesium	8.3 - 15.8	50	N/A	UT
Cyanide	2.5 - 4.7	50	381	No
Organics (ug/kg)				
1,1,1,2-Tetrachloroethane	1.281 - 1.333	3	N/A	UT
1,1,1-Trichloroethane	1.137 - 1.183	3	551,453	No
1,1,2,2-Tetrachloroethane	1.177 - 1.224	3	60,701	No
1,1,2-Trichloro-1,2,2-trifluoroethane	1.935 - 2.012	3	N/A	UT
1,1,2-Trichloroethane	0.963 - 1.001	3	N/A	UT
1,1-Dichloroethane	1.021 - 1.063	3	3,121	No
1,1-Dichloroethene	1.535 - 1.597	3	16,909	No
1,1-Dichloropropene	1.304 - 1.356	3	N/A	UT
1,2,3-Trichlorobenzene	1.476 - 1.536	3	N/A	UT
1,2,3-Trichloropropane	1.074 - 1.117	3	13,883	No
1,2,4-Trichlorobenzene	1.488 - 1.548	3	777	No
1,2,4-Trimethylbenzene	1.056 - 1.098	3	N/A	UT
1,2-Dibromo-3-chloropropane	2.76 - 2.87	3	N/A	UT
1,2-Dibromoethane	1.155 - 1.201	3	N/A	UT
1,2-Dichlorobenzene	1.329 - 1.383	3	N/A	UT
1,2-Dichloroethane	1.165 - 1.212	3	2,764	No
1,2-Dichloropropane	0.942 - 0.98	3	49,910	No
1,3,5-Trimethylbenzene	0.731 - 0.76	3	7,598	No
1,3-Dichlorobenzene	1.464 - 1.522	3	N/A	UT
1,3-Dichloropropane	0.817 - 0.85	3	N/A	UT
1,4-Dichlorobenzene	1.148 - 1.194	3	20,000	No
2,2-Dichloropropane	1.079 - 1.122	3	N/A	UT
2-Butanone	10.34 - 10.75	3	1.07E+06	No
2-Chlorotoluene	1.635 - 1.701	3	N/A	UT
2-Hexanone	8.279 - 8.612	3	N/A	UT
4-Chlorotoluene	0.959 - 0.997	3	N/A	UT
4-Isopropyltoluene	1.207 - 1.256	3	N/A	UT
4-Methyl-2-pentanone	6.999 - 7.28	3	14,630	No
Acetone	24.03 - 25.01	3	6,182	No
Benzene	0.888 - 0.923	3	500	No
Bromobenzene	1.347 - 1.4	3	N/A	UT
Bromochloromethane	1.291 - 1.343	3	N/A	UT
Bromodichloromethane	0.709 - 0.737	3	5,750	No
Bromoform	1.149 - 1.196	3	2,855	No
Bromomethane	1.651 - 1.717	3	N/A	UT
Carbon Disulfide	2.858 - 2.973	3	5,676	No
Carbon Tetrachloride	1.215 - 1.263	3	8,906	No
Chlorobenzene	1.022 - 1.064	3	4,750	No
Chloroethane	4.024 - 4.185	3	N/A	UT
Chloroform	0.926 - 0.963	3	8,655	No
Chloromethane	1.444 - 1.502	3	N/A	UT
cis-1,2-Dichloroethene	1.293 - 1.345	3	1,814	No

Table A1.3
Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil[a]

Analyte	Range of Reported Results	Total Number of Results	Lowest ESL	Maximum Reported Result > ESL?
cis-1,3-Dichloropropene	0.902 - 0.938	3	2,800	No
Dibromochloromethane	1.034 - 1.075	3	5,730	No
Dibromomethane	1.137 - 1.183	3	N/A	UT
Ethylbenzene	0.893 - 0.929	3	N/A	UT
Hexachlorobutadiene	1.568 - 1.63	3	431	No
Isopropylbenzene	1.337 - 1.39	3	N/A	UT
Methylene Chloride	1.336 - 1.39	3	3,399	No
Naphthalene	1.392 - 1.448	3	27,048	No
n-Butylbenzene	1.066 - 1.109	3	N/A	UT
n-Propylbenzene	1.187 - 1.234	3	N/A	UT
sec-Butylbenzene	1.124 - 1.17	3	N/A	UT
Styrene	1.079 - 1.122	3	16,408	No
tert-Butylbenzene	1.175 - 1.222	3	N/A	UT
Tetrachloroethene	1.408 - 1.463	3	763	No
Toluene	1.355 - 1.41	3	14,416	No
trans-1,2-Dichloroethene	1.437 - 1.495	3	25,617	No
trans-1,3-Dichloropropene	1.011 - 1.052	3	2,800	No
Trichloroethene	0.765 - 0.796	3	389	No
Trichlorofluoromethane	1.344 - 1.398	3	N/A	UT
Vinyl Chloride	3.031 - 3.153	3	97.7	No
Xylene[c]	2.693 - 2.801	3	1,140	No

[a] No analytes detected in less than 5 percent of samples.

[b] Value is the maximum reported result for nondetected analytes.

[c] The value for total xylene is used.

N/A = Not Available.

UT = Uncertain toxicity.

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Table A1.4

Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil

Analyte	Range of Reported Results	Total Number of Results	Prairie Dog NOAEL ESL	Maximum Reported Result >ESL?[a]
Inorganics (mg/kg)				
Antimony[b]	**0.28 - 33.8**	**69**	**18.7**	**Yes**
Boron	1 - 4.6	6	237	No
Cadmium	0.062 - 3	69	198	No
Cyanide	2.5 - 2.8	55	2,200	No
Organics (ug/kg)				
1,1,1,2-Tetrachloroethane	1.178 - 1.347	6	N/A	UT
1,1,1-Trichloroethane	1.044 - 7	53	4.85E+07	No
1,1,2,2-Tetrachloroethane	1.081 - 7	54	4.70E+06	No
1,1,2-Trichloro-1,2,2-trifluoroethane	1.778 - 2.032	6	N/A	UT
1,1,2-Trichloroethane	0.885 - 7	53	N/A	UT
1,1-Dichloroethane	0.938 - 7	53	215,360	No
1,1-Dichloroethene	1.411 - 7	53	1.28E+06	No
1,1-Dichloropropene	1.197 - 1.37	6	N/A	UT
1,2,3-Trichlorobenzene	1.357 - 1.551	6	N/A	UT
1,2,3-Trichloropropane	0.987 - 1.129	6	1.17E+06	No
1,2,4-Trichlorobenzene	1.368 - 370	61	94,484	No
1,2,4-Trimethylbenzene	0.97 - 1.109	6	N/A	UT
1,2-Dibromo-3-chloropropane	2.535 - 2.899	6	N/A	UT
1,2-Dibromoethane	1.061 - 1.213	6	N/A	UT
1,2-Dichlorobenzene	1.221 - 370	61	N/A	UT
1,2-Dichloroethane	1.07 - 7	53	2.00E+06	No
1,2-Dichloroethene	5 - 7	47	1.87E+06	No
1,2-Dichloropropane	0.865 - 7	53	3.92E+06	No
1,3,5-Trimethylbenzene	0.671 - 0.768	6	855,709	No
1,3-Dichlorobenzene	1.345 - 370	61	N/A	UT
1,3-Dichloropropane	0.751 - 0.859	6	N/A	UT
1,4-Dichlorobenzene	1.055 - 370	61	5.93E+06	No
2,2-Dichloropropane	0.992 - 1.134	6	N/A	UT
2,4,5-Trichlorophenol	1,700 - 1,900	55	N/A	UT
2,4,6-Trichlorophenol	330 - 370	55	17,263	No
2,4-Dichlorophenol	330 - 370	55	249,324	No
2,4-Dimethylphenol	330 - 370	55	N/A	UT
2,4-Dinitrophenol	1,700 - 1,900	45	4.90E+06	No
2,4-Dinitrotoluene	330 - 370	55	2,473	No
2,6-Dinitrotoluene	330 - 370	55	477,309	No
2-Butanone[b]	9.5 - 13	44	4.94E+07	No
2-Chloronaphthalene	330 - 370	55	N/A	UT
2-Chlorophenol	330 - 370	55	21,598	No
2-Chlorotoluene	1.503 - 1.719	6	N/A	UT
2-Hexanone	7.609 - 13	46	N/A	UT
2-Methylnaphthalene	330 - 370	55	319,121	No
2-Methylphenol	330 - 370	52	9.26E+06	No
2-Nitroaniline	1,700 - 1,900	55	418,475	No
2-Nitrophenol	330 - 370	55	N/A	UT

Table A1.4

Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil

Analyte	Range of Reported Results	Total Number of Results	Prairie Dog NOAEL ESL	Maximum Reported Result > ESL?[a]
3,3'-Dichlorobenzidine	660 - 740	52	N/A	UT
3-Nitroaniline	1,700 - 1,900	46	N/A	UT
4,6-Dinitro-2-methylphenol	1,700 - 1,900	54	44,283	No
4-Bromophenyl-phenylether	330 - 370	55	N/A	UT
4-Chloro-3-methylphenol	330 - 370	55	N/A	UT
4-Chloroaniline	330 - 370	52	48,856	No
4-Chlorophenyl-phenyl ether	330 - 370	55	N/A	UT
4-Chlorotoluene	0.881 - 1.008	6	N/A	UT
4-Isopropyltoluene	1.109 - 1.268	6	N/A	UT
4-Methyl-2-pentanone	6.431 - 13	46	859,131	No
4-Methylphenol	330 - 370	55	N/A	UT
4-Nitroaniline	1,700 - 1,900	55	2.62E+06	No
4-Nitrophenol	1,700 - 1,900	55	1.02E+06	No
Acenaphthene	330 - 370	55	N/A	UT
Acenaphthylene	330 - 370	55	N/A	UT
Anthracene	330 - 370	55	N/A	UT
Benzene	0.816 - 7	53	1.10E+06	No
Benzo(a)anthracene	330 - 370	55	N/A	UT
Benzo(a)pyrene	330 - 370	55	502,521	No
Benzo(b)fluoranthene	330 - 370	55	N/A	UT
Benzo(g,h,i)perylene	330 - 370	55	N/A	UT
Benzo(k)fluoranthene	330 - 370	55	N/A	UT
Benzoic Acid	1,700 - 1,900	52	N/A	UT
Benzyl Alcohol	330 - 370	52	253,015	No
bis(2-Chloroethoxy) methane	330 - 370	55	N/A	UT
bis(2-Chloroethyl) ether	330 - 370	55	N/A	UT
bis(2-Chloroisopropyl) ether	330 - 370	55	N/A	UT
Bromobenzene	1.238 - 1.415	6	N/A	UT
Bromochloromethane	1.186 - 1.356	6	N/A	UT
Bromodichloromethane	0.651 - 7	53	381,135	No
Bromoform	1.056 - 7	54	198,571	No
Bromomethane	1.517 - 13	53	N/A	UT
Butylbenzylphthalate	330 - 370	55	3.37E+06	No
Carbon Disulfide	2.627 - 7	49	410,941	No
Carbon Tetrachloride	1.116 - 7	53	736,154	No
Chlorobenzene	0.939 - 7	54	413,812	No
Chloroethane	3.697 - 13	53	N/A	UT
Chloroform[b]	0.85 - 7	53	560,030	No
Chloromethane	1.327 - 13	53	N/A	UT
Chrysene	330 - 370	55	N/A	UT
cis-1,2-Dichloroethene	1.188 - 1.359	6	132,702	No
cis-1,3-Dichloropropene	0.829 - 7	53	222,413	No
Dibenz(a,h)anthracene	330 - 370	55	N/A	UT
Dibenzofuran	330 - 370	55	2.44E+06	No
Dibromochloromethane	0.95 - 7	53	389,064	No

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Table A1.4

Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil

Analyte	Range of Reported Results	Total Number of Results	Prairie Dog NOAEL ESL	Maximum Reported Result > ESL?[a]
Dibromomethane	1.045 - 1.195	6	N/A	UT
Diethylphthalate[b]	330 - 370	53	2.21E+08	No
Dimethylphthalate	330 - 370	55	1.35E+07	No
Di-n-octylphthalate	330 - 370	55	2.58E+08	No
Ethylbenzene	0.821 - 7	54	N/A	UT
Fluoranthene	330 - 370	55	N/A	UT
Fluorene	330 - 370	55	N/A	UT
Hexachlorobenzene	330 - 370	55	190,142	No
Hexachlorobutadiene	1.441 - 370	61	150,894	No
Hexachlorocyclopentadiene	330 - 370	45	799,679	No
Hexachloroethane	330 - 370	55	45,656	No
Indeno(1,2,3-cd)pyrene	330 - 370	55	N/A	UT
Isophorone	330 - 370	55	N/A	UT
Isopropylbenzene	1.229 - 1.404	6	N/A	UT
Naphthalene	1.28 - 370	61	1.60E+07	No
n-Butylbenzene	0.98 - 1.12	6	N/A	UT
Nitrobenzene	330 - 370	55	N/A	UT
N-Nitroso-di-n-propylamine	330 - 370	55	N/A	UT
N-nitrosodiphenylamine	330 - 370	55	2.15E+06	No
n-Propylbenzene	1.09 - 1.246	6	N/A	UT
Pentachlorophenol	1,700 - 1,900	55	18,373	No
Phenanthrene	330 - 370	55	N/A	UT
Phenol	330 - 370	55	1.49E+06	No
Pyrene	330 - 370	55	N/A	UT
sec-Butylbenzene	1.033 - 1.182	6	N/A	UT
Styrene	0.992 - 7	54	1.53E+06	No
tert-Butylbenzene	1.08 - 1.235	6	N/A	UT
Tetrachloroethene	1.293 - 7	54	72,494	No
trans-1,2-Dichloroethene	1.32 - 1.51	6	1.87E+06	No
trans-1,3-Dichloropropene	0.929 - 7	54	222,413	No
Trichloroethene	0.703 - 7	53	32,424	No
Trichlorofluoromethane	1.235 - 1.413	6	N/A	UT
Vinyl acetate	10 - 13	47	730,903	No
Vinyl Chloride	2.786 - 13	53	6,494	No
Xylene[b,c]	2.475 - 7	53	111,663	No

[a] Value is the maximum reported result for nondetected analytes.

[b] Analyte has a detection frequency of less than 5 percent.

[c] The value for total xylene is used.

N/A = Not Available.

UT = Uncertain toxicity.

BOLD = Maximum reported result greater than the ESL.

COMPREHENSIVE RISK ASSESSMENT

INTER-DRAINAGE EXPOSURE UNIT

VOLUME 5: ATTACHMENT 2

Data Quality Assessment

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ACRONYMS AND ABBREVIATIONS

AA	atomic absorption
AI	adequate intake
ASD	Analytical Services Division
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
CRDL	contract required detection limit
DER	duplicate error ratio
DQA	Data Quality Assessment
DQO	data quality objective
DRC	data review checklist
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
EU	Exposure Unit
IAG	Interagency Agreement
ICP	inductively couple plasma
IDEU	Inter-Drainage Exposure Unit
IDL	instrument detection limit
LCS	laboratory control sample
MDA	minimum detectable activity
MDL	method detection limit
MS	matrix spike
MSA	method of standard additions

MSD	matrix spike duplicate
NIST	National Institute of Standards Technology
PARCC	precision, accuracy, representativeness, completeness, and comparability
PPT	pipette
PCB	polychlorinated biphenyl
QC	quality control
RDL	required detection limit
RFEDS	Rocky Flats Environmental Data System
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
RL	reporting limit
RPD	relative percent difference
SDP	standard data package
SOW	Statement of Work
SVOC	semi-volatile organic compound
SWD	Soil Water Database
TCLP	Toxicity Characteristic Leaching Procedure
TIC	tentatively identified compound
V&V	verification and validation
VOC	volatile organic compound

EXECUTIVE SUMMARY

This document provides an assessment of the quality of the data used in the Inter-Drainage Exposure Unit (EU) (IDEU) Comprehensive Risk Assessment (CRA). This Data Quality Assessment (DQA) focuses on all elements of quality control (QC) including both laboratory and sample-specific QC data.

Depending on the matrix and analyte group, anywhere from 84 to 100 percent of the IDEU data have been verified and/or validated by a validator from the Analytical Services Division (ASD) at the Rocky Flats Environmental Technology Site (RFETS) (or from an outside subcontractor) using verification and validation (V&V) guidelines for each analytical method developed for RFETS. V&V data are identified in the RFETS Soil Water Database (SWD) by a data qualifier flag and reason code(s) that provide an explanation for the qualifier flag. All rejected data have been removed from the data set used in the CRA because the validator has determined the data are unusable. The remaining V&V data have associated qualifier flags indicating that the data are valid, estimated, or undetected, and are used in the CRA. Of the IDEU V&V data, approximately 10 percent was qualified as estimated and/or undetected. Less than 1 percent of the data reported as detected by the laboratory were qualified as undetected due to blank contamination. Data qualified as estimated or undetected are a result of various minor laboratory noncompliance issues that are insufficient to render the data unusable. A review of the IDEU V&V data indicates that the data meet the data quality objectives (DQOs) outlined in the Final CRA Work Plan and Methodology (K-H 2004a) (hereafter referred to as the CRA Methodology) and, therefore, are adequate for use in the CRA. All non-V&V data were used as provided by the laboratory. A review of the most common observations found in the V&V data determined that a minimal amount, less than 1 percent, of the non-V&V data may have been qualified if a review had been performed. Based on this DQA, data for the SWEU are of sufficient quality for use in the CRA.

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1.0 INTRODUCTION

The Inter-Drainage Exposure Unit (EU) (IDEU) Comprehensive Risk Assessment (CRA) for the Rocky Flats Environmental Technology Site (RFETS) has been prepared in accordance with the CRA Methodology. The CRA Methodology was developed jointly with the regulatory agencies using the consultative process, and was approved by the agencies on September 28, 2004. Consistent with the CRA Methodology, data quality was assessed using a standard precision, accuracy, representativeness, completeness, and comparability (PARCC) parameter analysis (EPA 2002). Both laboratory and field quality control (QC) were evaluated for the IDEU data set.

Although many of the elements of QC that are reviewed in this document affect more than one PARCC parameter, their major impact on data quality is described below:

- Precision, as a measure of agreement among replicate measurements, is determined quantitatively based on the results of replicate laboratory measurements. Precision of the laboratory data was verified through review of:
  - Relative percent differences (RPDs) for laboratory control samples (LCSs) and LCS duplicates compared to the acceptable ranges (analytical precision);
  - RPDs (nonradionuclides) and duplicate error ratios (DERs) (radionuclides) for field sample and field duplicates compared to the acceptable ranges[1] (field precision);
  - RPDs for matrix spike (MS) and matrix spike duplicates (MSDs) compared to acceptable control ranges (matrix precision); and
  - RPDs for primary- and second-column analyses (analytical precision).
- Accuracy, as a measure of the distortion of a measurement process that causes error in measuring the true value, is determined quantitatively based on the analysis of samples with a known concentration. Accuracy of the laboratory data was verified through review of:
  - LCS data, calibration verification data, internal standard data, and instrument tune parameters (laboratory accuracy); and
  - Surrogate recoveries, MSs, and sample preparation (sample-specific accuracy).
- Representativeness of the data was verified through review of:

[1] The CRA Methodology states that the overall precision of the data is considered adequate if the RPD between the target and duplicate, at concentrations five times the reporting limit (RL), is less than 35 percent for solids and 20 percent for liquids. The precision adequacy requirement for radiological contaminants is a DER less than 1.96.

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- Laboratory blank data;
- Sample preservation/storage;
- Adherence to sample holding times;
- Documentation issues;
- Contract noncompliance issues; and
- Laboratory activities affecting ability to properly identify compounds.

- Completeness is a data adequacy criterion and is addressed in Appendix A, Volume 2 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report). It refers to the spatial and temporal distribution of the data, and their adequacy for estimating exposure point concentrations (EPCs) for the CRA.

- Comparability of the data was verified through evaluation of:
  - Analytical procedures, and whether they were standard U.S. Environmental Protection Agency (EPA)- and RFETS-approved procedures;
  - Instrument types and maintenance, sample preparation techniques, and standard units for reporting; and
  - MS and surrogate samples, ensuring accuracy within acceptable ranges.

2.0 ANALYTICAL DATA

Approximately 56,000 specific analytical records exist in the IDEU CRA data set, some 92 percent of which (51,456 records) have undergone verification and validation (V&V). The fraction of the data that was verified and/or validated is shown in Table A2.1 by analyte group and matrix. These data were reviewed by validators and their observations and comments are captured in the Soil Water Database (SWD). All of the data that have been flagged due to V&V findings (except "R"-flagged data) and data that have no flags as a result of V&V are used in the IDEU CRA. The small amount of data that has not undergone V&V is used as provided by the laboratories. The most common errors found during V&V such as transcription errors, calculation errors, and excluded records that were later added by the validator were reviewed to determine the possible effect on non-V&V data. Assuming that the percentage of data qualified with these issues is representative of the number of observations that would have been made if a review of the non-V&V data had been performed, less than 1 percent of the entire IDEU data set is at risk for such unacknowledged and, therefore, uncorrected errors.

Data V&V involves an in-depth review of the data packages from the laboratory to assess compliance with contract requirements. In general, data validation includes all of the activities of verification, as well as additional QC checks and review of some raw laboratory instrument data and calculations. After V&V, a data qualifier flag and/or reason code(s) are assigned to the data record (Tables A2.2 and A2.3). The reason codes provide an explanation for the qualifier flag, thereby making it possible to determine which of the PARCC parameters is affected by the observation (Table A2.4). Qualifier flags are discussed in this Data Quality Assessment (DQA) as those V&V flags that note issues in the data. V&V flags "V," "V1," and "1" represent data that were reviewed by validators, but no issues were observed. Eighty-six percent of the V&V data fall into this category. Additional qualifier flags such as "A," "E," and "Z" were also applied. These validation qualifiers are notations that do not indicate estimation or a change in the status of detection. The data are valid and useable as reported by the laboratory. Four percent of the V&V data are represented by these additional qualifier flags. The specific definitions of these additional V&V flags are presented in Table A2.2. Data with noted issues are presented in Table A2.5 and discussed in detail in Section 3.0.

V&V qualifier flags are not specifically addressed in this data assessment, but rather the reason codes associated with the qualifier flags for each analytical record are summarized and evaluated. This approach was chosen because the validator's specific observations (reason codes), and not the qualifier flags, provide the best descriptors of the data quality.

V&V data records contain a field with V&V reason codes (5, 18/52, 200, 99/101/701, and so forth), or the field is null. These reason codes represent observations related to assessment of precision, accuracy, and representativeness. For example, the reason code 110 definition (see Table A2.3) is "LCS recovery criteria were not met," which is an observation related to data accuracy.

Multiple reason codes were routinely applied to a specific sample method/matrix/analyte combination. Therefore, it was necessary to parse out the individual codes to create a table that included a unique record identifier and the associated parsed data V&V reason code (5, 18, 52, 200, 99, 101, 701, and so forth). With this information and the data V&V reason code definitions, the data validator's observations related to this data set can be re-created for each analytical record.

To summarize the reason codes in a logical manner for presentation, it was first necessary to group the reason codes that have slightly different definitions but convey the same meaning. A standardized definition was then applied to the individual reason codes within the group. The grouped reason codes were also assigned a QC category (for example, blanks, calibration, and holding time), and the affected PARCC parameter (Table A2.4). The reason codes were then summarized for each medium and analyte group within each QC category, applying the standardized definition to the summarized codes. The summary is presented in Table A2.5.

Rejected data (data qualifier flag "R"), consisting of approximately 3 percent of all V&V data, have been removed from the data used in the IDEU CRA because the validator has

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determined the data to be unusable. The fraction of the data that was rejected during validation and/or verification is shown in Table A2.6 by analyte group and matrix.

Finally, evaluating the RPD (DER for radionuclides) between a target sample and the associated field duplicate is not a QC parameter performed during V&V, but is still an important analysis when determining data precision. Because this analysis was not performed during V&V, the target sample/field duplicate RPD and DER calculations were performed separately and are presented in Table A2.7 as the number of exceedances per analyte group/matrix combination. Only those analyte group/matrix combinations having records that met the criteria for calculating an RPD or DER are presented. RPDs and DERs for target sample/field duplicate analyte pairs where one or both of the results are less than five times the RL are not calculated as outlined in the CRA Methodology.

3.0 FINDINGS

V&V observations affecting the CRA data set are summarized by analyte group/matrix/QC category/V&V observation in Table A2.5. The detected and nondetected results are summarized separately to give the reader a better idea of the impact on data usability. Only those issues observed in notable percentages (generally greater than 5 percent) of the data are discussed below in further detail. RPDs (DERs for radionuclides) presented in Table A2.7 are only discussed below when RPD (DER for radionuclides) exceedances of control criteria are greater than 10 percent for any given analyte group/matrix combination. Instances of elevated rates (greater than 10 percent) of rejected data are also discussed below.

3.1 Herbicides – Water

Calibration, documentation, and internal standard issues resulted in data V&V qualifications related to this analyte group/matrix combination. The percentage of observation is low with the exception of those records qualified due to transcription errors. Transcription errors, however, have no impact on data quality as all issues have previously been evaluated and corrected.

3.2 Metals – Soil

Blank, calibration, documentation, instrument setup, LCS, matrix, and other observations resulted in data V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low with the exception of those records qualified due to expired instrument detection limit (IDL) studies. While the importance of this QC parameter should not be overlooked, it is also important to note that the data were qualified as usable, although estimated.

3.3 Metals – Water

Blank, calibration, documentation, holding time, instrument setup, LCS, matrix, sensitivity, and other observations resulted in V&V qualifications associated with this analyte group/matrix combination. The percentage of observations is low with the exception of those records qualified due blank contamination. While the importance of blank analyses should not be overlooked, it is also important to note that the data were qualified as usable, although estimated.

3.4 Polychlorinated Biphenyls (PCBs) – Water

Documentation and surrogate issues resulted in data V&V observations related to this analyte group/matrix combination. While the percentage of noted transcription errors is high, the impact on data quality is minimal. All transcription errors have previously been evaluated and corrected. The percentage of records qualified because the surrogate recovery criteria were not met is also high, but it is important to note that the data were qualified as usable, although estimated.

3.5 Pesticides – Soil

None of the data associated with this analyte group and matrix were flagged with V&V observations. The amount of data that was rejected during V&V, however, is notable. Twelve percent of the V&V data for this analyte group/matrix combination were rejected, but 100 percent of all associated data underwent V&V. Consequently there is no possibility that any rejected data related to this analyte group and matrix were used in CRA.

3.6 Pesticides – Water

Blank, calibration, documentation, internal standard, and surrogate issues resulted in V&V qualification related to this analyte group/matrix combination. The percentage of observations is low with the exception of those records qualified due to transcription errors and low surrogate recoveries. Transcription errors have no impact on data quality as all issues have previously been evaluated and corrected. While the importance of surrogate analyses should not be overlooked, it is important to note that the data were qualified as usable, although estimated.

3.7 Radionuclides – Soil

Blank, calibration, documentation, instrument setup, LCS, matrix, sensitivity, and other observations resulted in V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low with the exception of those records qualified because the minimum detectable activity (MDA) of the instrument was calculated by the reviewer. Validator-calculated MDAs have no effect on data quality as all issues have previously been evaluated and corrected. Additionally, 15 percent of the

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V&V data associated with this analyte group and matrix was rejected. However, greater than 95 percent of the CRA data associated with this analyte group and matrix was either validated and/or verified, leaving a fraction of a percent that may have been rejected if a review had been performed.

3.8 Radionuclides – Water

Blank, calculation error, calibration, documentation, holding time, instrument setup, LCS, matrix, sensitivity, and other observations resulted in V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low with few exceptions. Insufficient documentation indicates that a complete V&V evaluation may not have been performed, but it is important to note that the data were qualified as usable, although estimated. Transcription errors and validator-calculated MDAs have no effect on data quality as all issues have previously been evaluated and corrected. While the importance of blank and continuing calibration verification analyses should not be overlooked, it is important to note that these records were also qualified as usable, although estimated. Most of those records qualified as directing the data user to the hard copy validation report for further explanation of the observation were also qualified as estimated. The CRA is performed with this uncertainty in mind, and no further effort was made to identify the issues.

3.9 Semi-Volatile Organic Compounds (SVOCs) – Soil

Blank observations resulted in V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low and within method expectations.

3.10 Semi-Volatile Organic Compounds – Water

Blank, calibration, documentation, holding time, internal standard, LCS, and other issues resulted in V&V observations related to this analyte group/matrix combination. With the exception of those records qualified because the internal standards did not meet control criteria, the percentage of observations is low and within method expectations. While the importance of internal standards analyses should not be overlooked, it is also important to note that the data were qualified as usable.

3.11 Volatile Organic Compounds (VOCs) – Soil

Blank, calibration, documentation, holding time, and matrix issues resulted in V&V observations related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

3.12 Volatile Organic Compounds – Water

Blank, calibration, confirmation, documentation, holding time, internal standard, LCS, and other issues resulted in V&V observations related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

3.13 Wet Chemistry Parameters – Soil

Holding time, matrix, and other issues resulted in V&V observations related to this analyte group/matrix combination. While the percentage of all observations, including the percentage of target sample/field duplicate analyte pairs exceeding RPD criteria is high, it is important to note that this analyte group contains numerous general chemistry parameters having little or no impact on site characterization.

3.14 Wet Chemistry Parameters – Water

Blank, calibration, documentation, holding time, LCS, matrix, and other issues resulted in V&V observations related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

4.0 CONCLUSIONS

The quality of the laboratory results were evaluated for compliance with the CRA Methodology data quality objectives (DQOs) through an overall review of PARCC parameters.

Of the data used in the IDEU CRA, approximately 92 percent underwent the V&V process. Of that 92 percent, 86 percent was qualified as having no QC issues, and approximately 10 percent was qualified as estimated or undetected (Table A2.8). The remaining 4 percent of the V&V data are made up of records qualified with additional flags indicating acceptable data such as "A," "E," or "P." Less than 1 percent of the data reported as detected by the laboratory were flagged as undetected by the validators due to blank contamination (Table A2.9). Data qualified as estimated or undetected indicate some issues with PARCC parameters, but not to a degree sufficient to mark the data unusable. Approximately 3 percent of the entire data set was rejected during the V&V process (Table A2.6).

Although many of the elements of QC that are reviewed in this document affect more than one PARCC parameter, the general discussion below summarizes the data quality per the validation reason codes affecting each specific PARCC parameter. Several V&V reason codes have no real impact on data quality because they represent issues that were noted but corrected, or represent observations related to missing documentation that was not required for data assessment. Approximately 9 percent of the IDEU V&V data were flagged with these "Other" V&V observations.

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- Precision, as a measure of agreement among replicate measurements, is determined quantitatively based on the results of replicate laboratory measurements.

  Of the V&V data, approximately 2 percent was noted for observations related to precision. Of that 2 percent, 98 percent was qualified for issues related to sample matrices and the remaining 2 percent was qualified for issues related to result confirmation or instrument setup. No LCS or instrument sensitivity issues related to precision were noted.

  RPDs and DERs for target sample/field duplicate pairs were found to be acceptable for all analyte group/matrix combinations. Overall, the method precision was found to be generally acceptable.

- Accuracy is a measure of the distortion of a measurement process that causes error in the true value.

  Of the V&V data, 23 percent was noted for accuracy-related observations. Of that 23 percent, 75 percent was noted for laboratory practice-related observations, while sample-specific accuracy observations make up the other 25 percent. Although the percentage of data with noted accuracy issues is slightly elevated, it is important to note that most of the data flagged with these accuracy-related observations are also flagged as estimated and the CRA is performed with this uncertainty in mind.

  Accuracy was generally acceptable with infrequent performance outside QC limits.

- Representativeness of the data was verified.

  Of the V&V data, approximately 35 percent was noted for observations related to representativeness. Of that 35 percent, 90 percent was qualified for blank observations, 4 percent for failure to observe allowed holding times, 2 percent for sensitivity issues, and 3 percent for documentation issues. Instrument setup, LCS, matrix, and other observations make up the other 4 percent of the data qualified for observations related to sample representativeness.

  Reportable levels of target analytes were not routinely detected in the laboratory blanks greater than the laboratory RLs except for relatively isolated incidences. Samples were generally stored and preserved properly. Overall, these elements of QC exceedances are indicative of normal laboratory operations and have little impact the sample data as reported.

  Sample data are representative of the site conditions at the time of sample collection.

- Comparability of the data was reviewed and no systematic errors were noted.

  - The use of standard EPA- and RFETS-approved analytical procedures;

- Instrument types and maintenance, sample preparation techniques, and standard units for reporting; and
- Evaluation of MS and surrogate samples, ensuring accuracy within acceptable ranges.

Examination of these parameters did not show any systematic issues with comparability.

- Completeness, as defined in the CRA Methodology, is addressed in Appendix A, Volume 2 of the RI/FS Report.

  Another indication of completeness that is sometimes used is a measure of the number of valid measurements obtained in relation to the total number of measurements planned.

  Because only 3 percent of the overall data were rejected, the use of non-V&V data for the IDEU CRA does not contribute to any completeness issues.

This review concludes that the PARCC of the data are generally acceptable and the CRA objectives have been met.

5.0 REFERENCES

K-H, 2004. Final Comprehensive Risk Assessment Work Plan and Methodology, Environmental Restoration, Rocky Flats Environmental Technology Site, Golden, Colorado. September.

EPA, 2002. Guidance for Quality Assurance Project Plans. EPA QA/G-5, EPA/240/R-02/009. Office of Environmental Information, Washington, D.C. December.

TABLES

Table A2.1
CRA Data V&V Summary

Analyte Group	Matrix	Total No. of V&V Records	Total No. of CRA Records	Percent V&V (%)
Dioxins and Furans	WATER	14	14	100.00
Herbicide	SOIL	55	55	100.00
Herbicide	WATER	142	153	92.81
Metal	SOIL	3,834	3,834	100.00
Metal	WATER	14,368	15,968	89.98
PCB	WATER	175	203	86.21
Pesticide	SOIL	45	45	100.00
Pesticide	WATER	836	921	90.77
Radionuclide	SOIL	689	723	95.30
Radionuclide	WATER	3,830	4,537	84.42
SVOC	SOIL	3,237	3,237	100.00
SVOC	WATER	1,758	1,905	92.28
VOC	SOIL	2,314	2,328	99.40
VOC	WATER	17,512	19,291	90.78
Wet Chem	SOIL	230	230	100.00
Wet Chem	WATER	2,417	2,682	90.12
	Total	**51,456**	**56,126**	**91.68%**

Table A2.2
V&V Qualifier Flag Definitions

Validation Qualifier Code	Description
1	QC data from a data package – Verification
A	Data acceptable with qualifications
B	Compound was found in BLK and sample
C	Calibration
E	Associated value exceeds calibration range; dilute and reanalyze
J	Estimated quantity – Validation
J1	Estimated quantity – Verification
JB	Organic method blank contamination – Validation
JB1	Organic method blank contamination – Verification
N	Historical – Validators asked not to validate this
NJ	Associated value is presumptively estimated
NJ1	Value presumptively estimated – Verification
P	Systematic error
R	Data unusable – Validation
R1	Data unusable – Verification
S	Matrix spike
U	Analyzed, not detected at/above method detection limit
U1	Analyzed, not detect at/above method detection limit – Verification
UJ	Associated value is considered estimated at an elevated detection
UJ1	Estimated at elevated level – Verification
V	No problems with the data – Validation
V1	No problems with the data – Verification
Y	Analytical results in validation process
Z	Validation was not requested or could not be performed

Table A2.3
V&V Reason Code Definitions

Validation Reason Code	Description
***	Unknown code from RFEDS
1	Holding times were exceeded
2	Holding times were grossly exceeded
3	Initial calibration correlation coefficient <0.995
4	Calibration verification criteria were not met
5	CRDL check sample recovery criteria were not met
6	Incorrect calibration of instrument
7	Analyte values > IDL were found in the blanks
8	Negative bias was indicated in the blanks
9	Interference indicated in the ICP interference check sample
10	Laboratory control sample recovery criteria were not met
11	Duplicate sample precision criteria were not met
12	Predigestion matrix spike criteria were not met (+/- 25 percent)
13	Predigestion matrix spike criteria were not met (<30 percent)
14	Post-digestion matrix spike recovery criteria were not met
15	MSA was required but not performed
16	MSA calibration correlation coefficient <0.995
17	Serial dilution criteria not met
18	Documentation was not provided
19	Calibration verification criteria not met
20	AA duplicate injection precision criteria were not met
21	Reagent blanks exceeded MDA
22	Tracer contamination
23	Improper aliquot size
24	Sample aliquot not taken quantitatively
25	Primary standard had exceeded expiration date
26	No raw data submitted by the laboratory
27	Recovery criteria were not met
28	Duplicate analysis was not performed
29	Verification criteria were not met
30	Replicate precision criteria were not met
31	Replicate analysis was not performed
32	Laboratory control samples >+/- 3 sigma
33	Laboratory control samples >+/- 2 sigma and <+/- 3 sigma
35	Transformed spectral index external ST criteria were not met
36	MDA exceeded the RDL
37	Sample exceeded efficiency curve weight limit
38	Excessive solids on planchet
39	Tune criteria not met
40	Organics initial calibration criteria were not met

Table A2.3
V&V Reason Code Definitions

Validation Reason Code	Description
41	Organics continuing calibration criteria were not met
42	Surrogates were outside criteria
43	Internal standards outside criteria
44	No mass spectra were provided
45	Results were not confirmed
47	Percent breakdown exceeded 20 percent
48	Linear range of instrument was exceeded
49	Method blank contamination
51	Nonverifiable laboratory results and/or unsubmitted data
52	Transcription error
53	Calculation error
54	Incorrect reported activity or MDA
55	Result exceeds linear range; serial dilution value reported
56	IDL changed due to significant figure discrepancy
57	Percent solids < 30 percent
58	Percent solids < 10 percent
59	Blank activity exceeded RDL
60	Blank recovery criteria were not met
61	Replicate recovery criteria were not met
62	LCS relative percent error criteria not met
63	LCS expected value not submitted/verifiable
64	Nontraceable/noncertified standard was used
67	Sample results not submitted/verifiable
68	Frequency of quality control samples not met
69	Samples not distilled
70	Resolution criteria not met
71	Unit conversion of results
72	Calibration counting statistics not met
73	Daily instrument performance assessment not performed
74	LCS data not submitted
75	Blank data not submitted
76	Instrument gain and/or efficiency not submitted
77	Detector efficiency criteria not met
78	MDAs were calculated by reviewer
79	Result obtained through dilution
80	Spurious counts of unknown origin
81	Repeat count outside of 3 sigma counting error
82	Sample results were not corrected for decay
83	Sample results were not included on Data Summary Table
84	Key fields wrong

Table A2.3
V&V Reason Code Definitions

Validation Reason Code	Description
85	Record added by QLI
86	Results considered qualitative not quantitative
87	Laboratory did no analysis for this record
88	Blank corrected results
89	Sample analysis was not requested
90	Sample result was not validated due to reanalysis
91	Unit conversion; QC sample activity/uncertainty/MDA
99	See hard copy for further explanation
101	Holding times were exceeded (attributed to laboratory problem)
102	Holding times were grossly exceeded (attribute to laboratory problem)
103	Calibration correlation coefficient does not meet requirement
104	Calibration verification recovery criteria were not met
105	Low-level check sample recovery criteria were not met
106	Calibration did not contain minimum number of standards
107	Analyte detected but < RDL in calibration blank verification
109	Interference indicated in the ICP interference check sample
110	Laboratory control sample recovery criteria were not met
111	Laboratory duplicate sample precision criteria were not met
112	Predigestion matrix spike criteria were not met (+/- 25 percent)
113	Predigestion matrix spike recovery is <30 percent
114	Post-digestion matrix spike criteria were not met
115	MSA was required but not performed
116	MSA calibration correlation coefficient <0.995
117	Serial dilution percent D criteria not met
123	Improper aliquot size
128	Laboratory duplicate was not analyzed
129	Verification criteria for frequency or sequence were not met
130	Replicate precision criteria were not met
131	Confirmation percent difference criteria not met
132	Laboratory control samples >+/- 3 sigma
136	MDA exceeded the RDL
139	Tune criteria not met
140	Requirements for independent calibration verification were not met
141	Continuing calibration verification criteria were not met
142	Surrogates were outside criteria
143	Internal standards outside criteria
145	Results were not confirmed
147	Percent breakdown exceeded 20 percent
148	Linear range of measurement system was exceeded
149	Method, preparation, or reagent blank contamination > RDL

Table A2.3
V&V Reason Code Definitions

Validation Reason Code	Description
150	Unknown carrier volume
152	Reported data do not agree with raw data
153	Calculation error
155	Original result exceeds linear range; serial dilution value reported
159	Magnitude of calibration verification blank result exceeded the RDL
164	Standard traceability or certification requirements not met
166	Carrier aliquot nonverifiable
168	QC sample frequency does not meet requirements
170	Resolution criteria not met
172	Calibration counting statistics not met
174	LCS data not submitted
175	Blank data not submitted
177	Detector efficiency criteria not met
188	Blank corrected results
199	See hard copy for further explanation
201	Preservation requirements not met by the laboratory
205	Unobtainable omissions or errors on SDP (required for databases)
206	Analyses were not requested according to the SOW
207	Sample pretreatment or sample preparation method is incorrect
211	Poor cleanup recovery
212	Instrument detection limit was not provided
213	Instrument detection limit is > the associated RDL
214	IDL is older than 3 months from date of analysis
215	Blank results were not reported to the IDL/MDL
216	Post-digestion spike recoveries outside of 85-115 percent criteria
217	Post-digestion spike recoveries were < 10 percent
218	Sample COC was not verifiable (attributed to laboratory)
219	Standards have expired or are not valid
220	TCLP sample percent solids < 0.5 percent
222	TCLP particle size was not performed
224	Incomplete TCLP extraction data
225	Insufficient TCLP extraction time
226	TIC misidentification
227	No documentation regarding deviations from methods or SOW
228	Calibration recoveries affecting data quality have not been met
229	Element not analyzed in ICP interference check sample
230	QC sample/analyte (e.g., spike, duplicate, LCS) not analyzed
231	MS/MSD criteria not met
232	Control limits not assigned correctly
233	Sample matrix QC does not represent samples analyzed

Table A2.3
V&V Reason Code Definitions

Validation Reason Code	Description
234	QC sample does not meet method requirement
235	Duplicate sample control limits do not pass
236	LCS control limits do not pass
237	Preparation blank control limits do not pass
238	Blank correction was not performed
239	Winsorized mean plus standard deviation of the same not calculated or calculated wrong
240	Sample preparations for soil/sludge/sediment were not homog/aliq properly
241	No micro PPT or electroplating data available
242	Tracer requirements were not met
243	Standard values were not calculated correctly (LCS, tracer, standards)
244	Standard or tracer is not NIST traceable
245	Energy calibration criteria not met
246	Background calibration criteria were not met
247	Sample or control analysis not chemically separated from each other
248	Single combined TCLP result was not repeated for sample with both mis+nonm
249	Result qualified due to blank contamination
250	Incorrect analysis sequence
251	Misidentified target compounds
252	Result is suspect DU
701	Holding times were exceeded (not attributed to laboratory)
702	Holding times were grossly exceeded (not attributed to laboratory)
703	Samples were not preserved properly in the field (not attributed to laboratory)
801	Missing deliverables (required for data assessment)
802	Missing deliverables (not required for data assessment)
803	Omissions or errors on SDP deliverables (required for data assessment)
804	Omissions or errors on SDP deliverables (not required for data assessment
805	Information missing from case narrative
806	Site samples not used for sample matrix QC
807	Original documentation not provided
808	Incorrect or incomplete DRC
809	Non-site samples reported with site samples
810	EDD does not match hard copy; EDD may be resubmitted

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Table A2.4

Standardized V&V Reason Code Definitions, QC Categories, and Affected PARCC Parameters

Validation Reason Codes	Standardized Description	QC Category	Affected PARCC Parameter
188, 88	Blank corrected results	Blanks	Representativeness
238	Blank correction was not performed	Blanks	Representativeness
175, 75	Blank data not submitted	Blanks	Representativeness
60	Blank recovery criteria were not met	Blanks	Representativeness
215	Blank results were not reported to the IDL/MDL	Blanks	Representativeness
107, 159	Calibration verification blank contamination	Blanks	Representativeness
149, 21, 237, 249, 49, 59, 7	Method, preparation, or reagent blank contamination	Blanks	Representativeness
8	Negative bias indicated in the blanks	Blanks	Representativeness
153, 53	Calculation error	Calculation Errors	Other
232	Control limits not assigned correctly	Calculation Errors	Other
246	Background calibration criteria were not met	Calibration	Accuracy
103, 3	Calibration correlation coefficient did not meet requirements	Calibration	Accuracy
172, 72	Calibration counting statistics did not meet criteria	Calibration	Accuracy
106	Calibration did not contain minimum number of standards	Calibration	Accuracy
228	Calibration requirements affecting data quality have not been met	Calibration	Accuracy
104, 141, 19, 29, 4, 40, 41	Continuing calibration verification criteria were not met	Calibration	Accuracy
245	Energy calibration criteria not met	Calibration	Accuracy
6	Incorrect calibration of instrument	Calibration	Accuracy
148, 48	Result exceeded linear range of measurement system	Calibration	Accuracy
155, 55	Original result exceeded linear range, serial dilution value reported	Calibration	Accuracy
140	Requirements for independent calibration verification were not met	Calibration	Accuracy
129	Frequency or sequencing verification criteria not met	Calibration	Accuracy
131	Confirmation percent difference criteria not met	Confirmation	Precision
145, 45	Results were not confirmed	Confirmation	Precision
18	Sufficient documentation not provided by the laboratory	Documentation issues	Representativeness
705	Electronic qualifiers were applied from validation report by hand	Documentation issues	Other
805	Information missing from case narrative	Documentation issues	Other
84	Key data field incorrect	Documentation issues	Other
802	Missing deliverables (not required for validation)	Documentation issues	Other
801	Missing deliverables (required for validation)	Documentation issues	Representativeness
227	No documentation regarding deviations from methods or SOW	Documentation issues	Other
44	No mass spectra were provided	Documentation issues	Representativeness
241	No micro pipette or electroplating data available	Documentation issues	Other
26	No raw data submitted by the laboratory	Documentation issues	Representativeness

Table A2.4

Standardized V&V Reason Code Definitions, QC Categories, and Affected PARCC Parameters

Validation Reason Codes	Standardized Description	QC Category	Affected PARCC Parameter
804	Omissions or errors in SDP (not required for validation)	Documentation issues	Other
803	Omissions or errors in SDP (required for validation)	Documentation issues	Representativeness
807	Original documentation not provided	Documentation issues	Other
85	Record added by the validator	Documentation issues	Other
152	Reported data do not agree with raw data	Documentation issues	Other
89	Sample analysis was not requested	Documentation issues	Other
218	Sample COC was not verifiable (attributed to laboratory)	Documentation issues	Representativeness
704	Sample COC was not verifiable (not attributed to laboratory)	Documentation issues	Representativeness
83	Sample results were not included on Data Summary Table	Documentation issues	Other
52	Transcription error	Documentation issues	Other
205	Unobtainable omissions or errors on SDP (required for data assessment)	Documentation issues	Representativeness
1, 101, 701	Holding times were exceeded	Holding times	Representativeness
2, 102, 702	Holding times were grossly exceeded	Holding times	Representativeness
251	Misidentified target compounds	Identification errors	Representativeness
70	Resolution criteria not met	Identification errors	Representativeness
226	TIC misidentification	Identification errors	Representativeness
143, 43	Internal standards did not meet criteria	Internal standards	Accuracy
5	CRDL check sample recovery criteria were not met	LCS	Accuracy
33	LCS > ± 2 sigma and < ± 3 sigma	LCS	Accuracy
10, 110, 236	LCS recovery criteria were not met	LCS	Accuracy
132, 32	Laboratory control samples > ± 3 sigma	LCS	Accuracy
174, 74	LCS data not submitted	LCS	Representativeness
63	Expected LCS value not submitted/verifiable	LCS	Representativeness
62	LCS relative percent error criteria not met	LCS	Accuracy
105	Low-level check sample recovery criteria were not met	LCS	Accuracy
230	QC sample/analyte (e.g., spike, duplicate, LCS) not analyzed	LCS	Representativeness
28	Duplicate analysis was not performed	Matrices	Precision
11, 235	Duplicate sample precision criteria were not met	Matrices	Precision
111	LCS/LCSD precision criteria were not met	Matrices	Precision
128	Laboratory duplicate was not analyzed	Matrices	Precision
231	MS/MSD criteria not met	Matrices	Precision
116, 16	MSA calibration correlation coefficient <0.995	Matrices	Accuracy
115, 15	MSA was required but not performed	Matrices	Representativeness
58	Sample contained < 10 percent solid material	Matrices	Representativeness
57	Sample contained < 30 percent solid material	Matrices	Representativeness
217	Post-digestion spike recoveries were < 10%	Matrices	Accuracy
14, 114, 216	Post-digestion matrix spike criteria were not met	Matrices	Accuracy
113, 13	Predigestion matrix spike recovery is <30%	Matrices	Accuracy

Table A2.4

Standardized V&V Reason Code Definitions, QC Categories, and Affected PARCC Parameters

Validation Reason Code	Standardized Description	QC Category	Affected PARCC Parameter
112, 12	Predigestion matrix spike recovery criteria were not met	Matrices	Accuracy
27	Recovery criteria were not met	Matrices	Accuracy
31	Replicate analysis was not performed	Matrices	Precision
130, 30	Replicate precision criteria were not met	Matrices	Precision
61	Replicate recovery criteria were not met	Matrices	Accuracy
233	Sample matrix QC does not represent samples analyzed	Matrices	Representativeness
117, 17	Serial dilution criteria not met	Matrices	Accuracy
806	Site samples not used for sample matrix QC	Matrices	Representativeness
810	EDD does not match hard copy; EDD may be resubmitted	Other	Other
214	IDL is older than 3 months from date of analysis	Other	Accuracy
250	Incorrect analysis sequence	Other	Representativeness
808	Incorrect or incomplete DRC	Other	Representativeness
212	Instrument detection limit was not provided	Other	Other
87	Laboratory did no analysis for this record	Other	Other
809	Nonsite samples reported with Site samples	Other	Other
64	Nontraceable/noncertified standard was used	Other	Accuracy
51	Nonverifiable laboratory results and/or unsubmitted data	Other	Representativeness
211	Poor cleanup recovery	Other	Accuracy
25	Primary standard had exceeded expiration date	Other	Accuracy
234	QC sample does not meet method requirement	Other	Representativeness
168, 68	QC sample frequency does not meet requirements	Other	Representativeness
252	Result is suspect due to dilution	Other	Other
79	Result obtained through dilution	Other	Other
37	Sample exceeded efficiency curve weight limit	Other	Accuracy
247	Sample or control analyses not chemically separated from each other	Other	Representativeness
90	Sample result was not validated due to re-analysis	Other	Other
67	Sample results not submitted/verifiable	Other	Representativeness
199, 99	See hard copy for further explanation	Other	Other
248	Single combined TCLP results was not reported for sample with both mis+nonm	Other	Accuracy
80	Spurious counts of unknown origin	Other	Representativeness
244	Standard or tracer is not NIST traceable	Other	Accuracy
164	Standard traceability or certification requirements not met	Other	Accuracy
219	Standards have expired or are not valid	Other	Accuracy
243	Standard values were not calculated correctly (LCS, tracer, standards)	Other	Other
22	Tracer contamination	Other	Accuracy
242	Tracer requirements were not met	Other	Accuracy
71	Unit conversion of results	Other	Other

Table A2.4

Standardized V&V Reason Code Definitions, QC Categories, and Affected PARCC Parameters

Validation Reason Codes	Standardized Description	QC Category	Affected PARCC Parameter
239	Winsorized mean+standard deviation of the same not calculated or calculated wrong	Other	Other
38	Excessive solids on planchet	Sample preparation	Accuracy
123, 23	Improper aliquot size	Sample preparation	Accuracy
224	Incomplete TCLP extraction data	Sample preparation	Representativeness
225	Insufficient TCLP extraction time	Sample preparation	Representativeness
201	Preservation requirements not met by the laboratory	Sample preparation	Representativeness
24	Sample aliquot not taken quantitatively	Sample preparation	Accuracy
240	Sample preparation for soil/sludge/ sediment were not homog/aliq properly	Sample preparation	Representativeness
207	Sample pretreatment or preparation method is incorrect	Sample preparation	Representativeness
69	Samples not distilled	Sample preparation	Representativeness
703	Samples were not preserved properly in the field	Sample preparation	Representativeness
222	TCLP particle size was not performed	Sample preparation	Representativeness
220	TCLP sample percent solids < 0.5 percent	Sample preparation	Representativeness
56	IDL changed due to significant figure discrepancy	Sensitivity	Representativeness
54	Incorrect reported activity or MDA	Sensitivity	Other
213	Instrument detection limit > the associated RDL	Sensitivity	Representativeness
136, 36	MDA exceeded the RDL	Sensitivity	Representativeness
78	MDA was calculated by reviewer	Sensitivity	Other
81	Repeat count outside of 3 sigma counting error	Sensitivity	Precision
86	Results considered qualitative not quantitative	Sensitivity	Accuracy
82	Sample results were not corrected for decay	Sensitivity	Other
91	Unit conversion, QC sample activity uncertainty/MDA	Sensitivity	Representativeness
142, 42	Surrogates were outside criteria	Surrogate	Accuracy
20	AA duplicate injection precision criteria were not met	Instrument Set-up	Precision
73	Daily instrument performance assessment not performed	Instrument Set-up	Accuracy
177, 77	Detector efficiency criteria not met	Instrument Set-up	Accuracy
229	Element not analyzed in ICP interference check sample	Instrument Set-up	Representativeness
76	Instrument gain and/or efficiency not submitted	Instrument Set-up	Representativeness
109, 9	Interference indicated in the ICP interference check sample	Instrument Set-up	Accuracy
147, 47	Percent breakdown exceeded 20 percent	Instrument Set-up	Representativeness
170	Resolution criteria not met	Instrument Set-up	Representativeness
35	Transformed spectral index external site criteria were not met	Instrument Set-up	Representativeness
139, 39	Tune criteria not met	Instrument Set-up	Accuracy
206	Analysis was not requested according to SOW	Unknown	Other
166	Carrier aliquot nonverifiable	Unknown	Representativeness
150	Unknown carrier volume	Unknown	Representativeness

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Herbicide	WATER	Calibration	Continuing calibration verification criteria were not met	No	3	142	2.11
Herbicide	WATER	Documentation Issues	Transcription error	No	21	142	14.79
Herbicide	WATER	Documentation Issues	Transcription error	Yes	20	142	14.08
Herbicide	WATER	Internal Standards	Internal standards did not meet criteria	No	2	142	1.41
Metal	SOIL	Blanks	Calibration verification blank contamination	No	39	3,834	1.02
Metal	SOIL	Blanks	Method, preparation, or reagent blank contamination	No	164	3,834	4.28
Metal	SOIL	Blanks	Method, preparation, or reagent blank contamination	Yes	9	3,834	0.23
Metal	SOIL	Blanks	Negative bias indicated in the blanks	No	49	3,834	1.28
Metal	SOIL	Blanks	Negative bias indicated in the blanks	Yes	12	3,834	0.31
Metal	SOIL	Calibration	Calibration correlation coefficient did not meet requirements	No	10	3,834	0.26
Metal	SOIL	Calibration	Calibration correlation coefficient did not meet requirements	Yes	14	3,834	0.37
Metal	SOIL	Documentation Issues	Transcription error	Yes	6	3,834	0.16
Metal	SOIL	Instrument Set-up	Interference was indicated in the interference check sample	No	4	3,834	0.10
Metal	SOIL	Instrument Set-up	Interference was indicated in the interference check sample	Yes	12	3,834	0.31
Metal	SOIL	LCS	CRDL check sample recovery criteria were not met	No	10	3,834	0.26
Metal	SOIL	LCS	CRDL check sample recovery criteria were not met	Yes	10	3,834	0.26
Metal	SOIL	LCS	LCS recovery criteria were not met	No	124	3,834	3.23
Metal	SOIL	LCS	LCS recovery criteria were not met	Yes	181	3,834	4.72
Metal	SOIL	LCS	Low level check sample recovery criteria were not met	No	43	3,834	1.12
Metal	SOIL	LCS	Low level check sample recovery criteria were not met	Yes	27	3,834	0.70
Metal	SOIL	Matrices	Duplicate sample precision criteria were not met	No	10	3,834	0.26
Metal	SOIL	Matrices	Duplicate sample precision criteria were not met	Yes	56	3,834	1.46
Metal	SOIL	Matrices	LCS/LCSD precision criteria were not met	Yes	9	3,834	0.23
Metal	SOIL	Matrices	Post-digestion MS did not meet control criteria	No	8	3,834	0.21
Metal	SOIL	Matrices	Post-digestion MS did not meet control criteria	Yes	14	3,834	0.37
Metal	SOIL	Matrices	Predigestion MS recovery criteria were not met	No	104	3,834	2.71
Metal	SOIL	Matrices	Predigestion MS recovery criteria were not met	Yes	183	3,834	4.77
Metal	SOIL	Matrices	Predigestion MS recovery was < 30 percent	Yes	9	3,834	0.23
Metal	SOIL	Matrices	Serial dilution criteria were not met	Yes	74	3,834	1.93
Metal	SOIL	Other	IDL is older than 3 months from date of analysis	No	162	3,834	4.23
Metal	SOIL	Other	IDL is older than 3 months from date of analysis	Yes	438	3,834	11.42
Metal	WATER	Blanks	Calibration verification blank contamination	No	57	14,368	0.40

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Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Metal	WATER	Blanks	Calibration verification blank contamination	Yes	6	14,368	0.04
Metal	WATER	Blanks	Method, preparation, or reagent blank contamination	No	1,354	14,368	9.42
Metal	WATER	Blanks	Method, preparation, or reagent blank contamination	Yes	188	14,368	1.31
Metal	WATER	Blanks	Negative bias indicated in the blanks	No	198	14,368	1.38
Metal	WATER	Blanks	Negative bias indicated in the blanks	Yes	99	14,368	0.69
Metal	WATER	Calibration	Calibration correlation coefficient did not meet requirements	No	81	14,368	0.56
Metal	WATER	Calibration	Calibration correlation coefficient did not meet requirements	Yes	14	14,368	0.10
Metal	WATER	Calibration	Continuing calibration verification criteria were not met	No	8	14,368	0.06
Metal	WATER	Documentation Issues	Key data fields incorrect	No	5	14,368	0.03
Metal	WATER	Documentation Issues	Key data fields incorrect	Yes	20	14,368	0.14
Metal	WATER	Documentation Issues	Record added by the validator	No	34	14,368	0.24
Metal	WATER	Documentation Issues	Record added by the validator	Yes	22	14,368	0.15
Metal	WATER	Documentation Issues	Transcription error	No	816	14,368	5.68
Metal	WATER	Documentation Issues	Transcription error	Yes	187	14,368	1.30
Metal	WATER	Holding Times	Holding times were exceeded	No	1	14,368	0.01
Metal	WATER	Instrument Set-up	AA duplicate injection precision criteria were not met	Yes	1	14,368	0.01
Metal	WATER	Instrument Set-up	Interference was indicated in the interference check sample	No	7	14,368	0.05
Metal	WATER	Instrument Set-up	Interference was indicated in the interference check sample	Yes	13	14,368	0.09
Metal	WATER	LCS	CRDL check sample recovery criteria were not met	No	63	14,368	0.44
Metal	WATER	LCS	CRDL check sample recovery criteria were not met	Yes	70	14,368	0.49
Metal	WATER	LCS	LCS recovery criteria were not met	No	4	14,368	0.03
Metal	WATER	LCS	LCS recovery criteria were not met	Yes	13	14,368	0.09
Metal	WATER	LCS	Low level check sample recovery criteria were not met	No	2	14,368	0.01
Metal	WATER	LCS	Low level check sample recovery criteria were not met	Yes	5	14,368	0.03
Metal	WATER	Matrices	Duplicate sample precision criteria were not met	No	24	14,368	0.17
Metal	WATER	Matrices	Duplicate sample precision criteria were not met	Yes	133	14,368	0.93
Metal	WATER	Matrices	MSA calibration correlation coefficient < 0.995	Yes	1	14,368	0.01
Metal	WATER	Matrices	Post-digestion MS did not meet control criteria	No	112	14,368	0.78
Metal	WATER	Matrices	Post-digestion MS did not meet control criteria	Yes	17	14,368	0.12
Metal	WATER	Matrices	Predigestion MS recovery criteria were not met	No	201	14,368	1.40
Metal	WATER	Matrices	Predigestion MS recovery criteria were not met	Yes	154	14,368	1.07
Metal	WATER	Matrices	Predigestion MS recovery was < 30 percent	Yes	2	14,368	0.01

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Metal	WATER	Matrices	Serial dilution criteria were not met	No	2	14,368	0.01
Metal	WATER	Matrices	Serial dilution criteria were not met	Yes	141	14,368	0.98
Metal	WATER	Other	IDL is older than 3 months from date of analysis	No	51	14,368	0.35
Metal	WATER	Other	IDL is older than 3 months from date of analysis	Yes	61	14,368	0.42
Metal	WATER	Other	See hard copy for further explanation	No	1	14,368	0.01
Metal	WATER	Sensitivity	IDL changed due to a significant figure discrepancy	No	72	14,368	0.50
PCB	WATER	Documentation Issues	Sample analysis was not requested	No	7	175	4.00
PCB	WATER	Documentation Issues	Transcription error	No	61	175	34.86
PCB	WATER	Surrogates	Surrogate recovery criteria were not met	No	56	175	32.00
Pesticide	WATER	Blanks	Method, preparation, or reagent blank contamination	No	4	836	0.48
Pesticide	WATER	Calibration	Continuing calibration verification criteria were not met	No	17	836	2.03
Pesticide	WATER	Calibration	Continuing calibration verification criteria were not met	Yes	1	836	0.12
Pesticide	WATER	Documentation Issues	Transcription error	No	92	836	11.00
Pesticide	WATER	Internal Standards	Internal standards did not meet criteria	No	2	836	0.24
Pesticide	WATER	Surrogates	Surrogate recovery criteria were not met	No	208	836	24.88
Pesticide	WATER	Surrogates	Surrogate recovery criteria were not met	Yes	2	836	0.24
Radionuclide	SOIL	Blanks	Blank recovery criteria were not met	Yes	7	689	1.02
Radionuclide	SOIL	Blanks	Method, preparation, or reagent blank contamination	Yes	14	689	2.03
Radionuclide	SOIL	Calibration	Continuing calibration verification criteria were not met	Yes	8	689	1.16
Radionuclide	SOIL	Documentation Issues	Record added by the validator	Yes	8	689	1.16
Radionuclide	SOIL	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	31	689	4.50
Radionuclide	SOIL	Documentation Issues	Transcription error	No	20	689	2.90
Radionuclide	SOIL	Documentation Issues	Transcription error	Yes	33	689	4.79
Radionuclide	SOIL	Instrument Set-up	Resolution criteria were not met	No	6	689	0.87
Radionuclide	SOIL	Instrument Set-up	Resolution criteria were not met	Yes	14	689	2.03
Radionuclide	SOIL	LCS	LCS recovery > +/- 3 sigma	Yes	6	689	0.87
Radionuclide	SOIL	LCS	LCS recovery criteria were not met	Yes	5	689	0.73
Radionuclide	SOIL	LCS	LCS relative percent error criteria not met	Yes	1	689	0.15
Radionuclide	SOIL	Matrices	Recovery criteria were not met	No	1	689	0.15
Radionuclide	SOIL	Matrices	Recovery criteria were not met	Yes	1	689	0.15
Radionuclide	SOIL	Matrices	Replicate precision criteria were not met	Yes	4	689	0.58
Radionuclide	SOIL	Other	QC sample does not meet method requirements	No	14	689	2.03

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Radionuclide	SOIL	Other	QC sample does not meet method requirements	Yes	11	689	1.60
Radionuclide	SOIL	Other	Sample exceeded efficiency curve weight limit	Yes	4	689	0.58
Radionuclide	SOIL	Sensitivity	MDA exceeded the RDL	No	2	689	0.29
Radionuclide	SOIL	Sensitivity	MDA was calculated by reviewer	Yes	54	689	7.84
Radionuclide	WATER	Blanks	Blank recovery criteria were not met	No	13	3,830	0.34
Radionuclide	WATER	Blanks	Blank recovery criteria were not met	Yes	31	3,830	0.81
Radionuclide	WATER	Blanks	Method, preparation, or reagent blank contamination	No	66	3,830	1.72
Radionuclide	WATER	Blanks	Method, preparation, or reagent blank contamination	Yes	282	3,830	7.36
Radionuclide	WATER	Calculation Errors	Calculation error	No	1	3,830	0.03
Radionuclide	WATER	Calculation Errors	Calculation error	Yes	1	3,830	0.03
Radionuclide	WATER	Calibration	Calibration counting statistics did not meet criteria	No	14	3,830	0.37
Radionuclide	WATER	Calibration	Continuing calibration verification criteria were not met	No	62	3,830	1.62
Radionuclide	WATER	Calibration	Continuing calibration verification criteria were not met	Yes	511	3,830	13.34
Radionuclide	WATER	Documentation Issues	Key data fields incorrect	No	1	3,830	0.03
Radionuclide	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	No	1	3,830	0.03
Radionuclide	WATER	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	8	3,830	0.21
Radionuclide	WATER	Documentation Issues	Record added by the validator	Yes	6	3,830	0.16
Radionuclide	WATER	Documentation Issues	Sufficient documentation not provided by the laboratory	No	26	3,830	0.68
Radionuclide	WATER	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	441	3,830	11.51
Radionuclide	WATER	Documentation Issues	Transcription error	No	274	3,830	7.15
Radionuclide	WATER	Documentation Issues	Transcription error	Yes	227	3,830	5.93
Radionuclide	WATER	Holding Times	Holding times were exceeded	No	5	3,830	0.13
Radionuclide	WATER	Holding Times	Holding times were exceeded	Yes	4	3,830	0.10
Radionuclide	WATER	Instrument Set-up	Resolution criteria were not met	No	8	3,830	0.21
Radionuclide	WATER	Instrument Set-up	Resolution criteria were not met	Yes	21	3,830	0.55
Radionuclide	WATER	Instrument Set-up	Transformed spectral index external site criteria were not met	No	11	3,830	0.29
Radionuclide	WATER	Instrument Set-up	Transformed spectral index external site criteria were not met	Yes	1	3,830	0.03
Radionuclide	WATER	LCS	Expected LCS value not submitted/verifiable	No	7	3,830	0.18
Radionuclide	WATER	LCS	Expected LCS value not submitted/verifiable	Yes	39	3,830	1.02
Radionuclide	WATER	LCS	LCS data not submitted by the laboratory	Yes	1	3,830	0.03
Radionuclide	WATER	LCS	LCS recovery > +/- 3 sigma	No	95	3,830	2.48
Radionuclide	WATER	LCS	LCS recovery > +/- 3 sigma	Yes	107	3,830	2.79

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Radionuclide	WATER	LCS	LCS recovery criteria were not met	No	5	3,830	0.13
Radionuclide	WATER	LCS	LCS recovery criteria were not met	Yes	29	3,830	0.76
Radionuclide	WATER	LCS	LCS relative percent error criteria not met	No	20	3,830	0.52
Radionuclide	WATER	LCS	LCS relative percent error criteria not met	Yes	108	3,830	2.82
Radionuclide	WATER	Matrices	Recovery criteria were not met	No	7	3,830	0.18
Radionuclide	WATER	Matrices	Recovery criteria were not met	Yes	17	3,830	0.44
Radionuclide	WATER	Matrices	Replicate analysis was not performed	No	17	3,830	0.44
Radionuclide	WATER	Matrices	Replicate analysis was not performed	Yes	63	3,830	1.64
Radionuclide	WATER	Matrices	Replicate precision criteria were not met	No	25	3,830	0.65
Radionuclide	WATER	Matrices	Replicate precision criteria were not met	Yes	194	3,830	5.07
Radionuclide	WATER	Matrices	Replicate recovery criteria were not met	No	13	3,830	0.34
Radionuclide	WATER	Matrices	Replicate recovery criteria were not met	Yes	45	3,830	1.17
Radionuclide	WATER	Other	Lab results not verified due to unsubmitted data	No	4	3,830	0.10
Radionuclide	WATER	Other	Lab results not verified due to unsubmitted data	Yes	13	3,830	0.34
Radionuclide	WATER	Other	Sample exceeded efficiency curve weight limit	Yes	1	3,830	0.03
Radionuclide	WATER	Other	Sample results were not validated due to re-analysis	No	1	3,830	0.03
Radionuclide	WATER	Other	See hard copy for further explanation	No	9	3,830	0.23
Radionuclide	WATER	Other	See hard copy for further explanation	Yes	224	3,830	5.85
Radionuclide	WATER	Other	Unit conversion of results	Yes	1	3,830	0.03
Radionuclide	WATER	Sensitivity	Incorrect reported activity or MDA	Yes	12	3,830	0.31
Radionuclide	WATER	Sensitivity	MDA exceeded the RDL	No	16	3,830	0.42
Radionuclide	WATER	Sensitivity	MDA exceeded the RDL	Yes	104	3,830	2.72
Radionuclide	WATER	Sensitivity	MDA was calculated by reviewer	No	6	3,830	0.16
Radionuclide	WATER	Sensitivity	MDA was calculated by reviewer	Yes	1,063	3,830	27.75
SVOC	SOIL	Blanks	Method, preparation, or reagent blank contamination	No	30	3,237	0.93
SVOC	WATER	Blanks	Method, preparation, or reagent blank contamination	No	8	1,758	0.46
SVOC	WATER	Calibration	Continuing calibration verification criteria were not met	No	16	1,758	0.91
SVOC	WATER	Documentation Issues	Transcription error	No	63	1,758	3.58
SVOC	WATER	Holding Times	Holding times were exceeded	No	2	1,758	0.11
SVOC	WATER	Internal Standards	Internal standards did not meet criteria	No	105	1,758	5.97
SVOC	WATER	LCS	LCS recovery criteria were not met	No	20	1,758	1.14
SVOC	WATER	Other	Sample results were not validated due to re-analysis	No	3	1,758	0.17

Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
VOC	SOIL	Blanks	Method, preparation, or reagent blank contamination	No	1	2,314	0.04
VOC	SOIL	Calibration	Continuing calibration verification criteria were not met	Yes	7	2,314	0.30
VOC	SOIL	Documentation Issues	Sample analysis was not requested	No	10	2,314	0.43
VOC	SOIL	Documentation Issues	Sample analysis was not requested	Yes	1	2,314	0.04
VOC	SOIL	Holding Times	Holding times were exceeded	No	34	2,314	1.47
VOC	SOIL	Matrices	Percent solids < 30 percent	No	1	2,314	0.04
VOC	SOIL	Matrices	Percent solids < 30 percent	Yes	1	2,314	0.04
VOC	WATER	Blanks	Method, preparation, or reagent blank contamination	No	90	17,512	0.51
VOC	WATER	Blanks	Method, preparation, or reagent blank contamination	Yes	9	17,512	0.05
VOC	WATER	Calibration	Continuing calibration verification criteria were not met	No	30	17,512	0.17
VOC	WATER	Calibration	Continuing calibration verification criteria were not met	Yes	9	17,512	0.05
VOC	WATER	Confirmation	Results were not confirmed	No	9	17,512	0.05
VOC	WATER	Confirmation	Results were not confirmed	Yes	2	17,512	0.01
VOC	WATER	Documentation Issues	Record added by the validator	No	278	17,512	1.59
VOC	WATER	Documentation Issues	Record added by the validator	Yes	3	17,512	0.02
VOC	WATER	Documentation Issues	Transcription error	No	556	17,512	3.17
VOC	WATER	Documentation Issues	Transcription error	Yes	5	17,512	0.03
VOC	WATER	Holding Times	Holding times were exceeded	No	48	17,512	0.27
VOC	WATER	Holding Times	Holding times were exceeded	Yes	3	17,512	0.02
VOC	WATER	Internal Standards	Internal standards did not meet criteria	No	36	17,512	0.21
VOC	WATER	LCS	CRDL check sample recovery criteria were not met	Yes	1	17,512	0.01
VOC	WATER	LCS	LCS recovery criteria were not met	No	198	17,512	1.13
VOC	WATER	LCS	LCS recovery criteria were not met	Yes	2	17,512	0.01
VOC	WATER	Other	Sample results were not validated due to re-analysis	No	53	17,512	0.30
VOC	WATER	Other	Sample results were not validated due to re-analysis	Yes	1	17,512	0.01
VOC	WATER	Other	See hard copy for further explanation	Yes	1	17,512	0.01
Wet Chem	SOIL	Holding Times	Holding times were exceeded	No	10	230	4.35
Wet Chem	SOIL	Holding Times	Holding times were exceeded	Yes	38	230	16.52
Wet Chem	SOIL	Matrices	Predigestion MS recovery was < 30 percent	Yes	20	230	8.70
Wet Chem	SOIL	Other	IDL is older than 3 months from date of analysis	Yes	20	230	8.70
Wet Chem	WATER	Blanks	Method, preparation, or reagent blank contamination	No	39	2,417	1.61
Wet Chem	WATER	Blanks	Method, preparation, or reagent blank contamination	Yes	3	2,417	0.12

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Table A2.5
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect ?	No. of Qualified Results	Total No. of V&V Records	Percent Qualified (%)
Wet Chem	WATER	Blanks	Negative bias indicated in the blanks	No	17	2,417	0.70
Wet Chem	WATER	Blanks	Negative bias indicated in the blanks	Yes	5	2,417	0.21
Wet Chem	WATER	Calibration	Calibration correlation coefficient did not meet requirements	Yes	8	2,417	0.33
Wet Chem	WATER	Calibration	Continuing calibration verification criteria were not met	Yes	26	2,417	1.08
Wet Chem	WATER	Documentation Issues	Record added by the validator	No	4	2,417	0.17
Wet Chem	WATER	Documentation Issues	Record added by the validator	Yes	5	2,417	0.21
Wet Chem	WATER	Documentation Issues	Transcription error	No	46	2,417	1.90
Wet Chem	WATER	Documentation Issues	Transcription error	Yes	81	2,417	3.35
Wet Chem	WATER	Holding Times	Holding times were exceeded	No	24	2,417	0.99
Wet Chem	WATER	Holding Times	Holding times were exceeded	Yes	22	2,417	0.91
Wet Chem	WATER	Holding Times	Holding times were grossly exceeded	No	21	2,417	0.87
Wet Chem	WATER	Holding Times	Holding times were grossly exceeded	Yes	26	2,417	1.08
Wet Chem	WATER	LCS	LCS recovery criteria were not met	No	4	2,417	0.17
Wet Chem	WATER	LCS	LCS recovery criteria were not met	Yes	1	2,417	0.04
Wet Chem	WATER	Matrices	Duplicate sample precision criteria were not met	Yes	2	2,417	0.08
Wet Chem	WATER	Matrices	Predigestion MS recovery criteria were not met	No	14	2,417	0.58
Wet Chem	WATER	Matrices	Predigestion MS recovery criteria were not met	Yes	58	2,417	2.40
Wet Chem	WATER	Other	Lab results not verified due to unsubmitted data	No	5	2,417	0.21
Wet Chem	WATER	Other	Lab results not verified due to unsubmitted data	Yes	15	2,417	0.62
Wet Chem	WATER	Other	See hard copy for further explanation	No	1	2,417	0.04

Table A2.6
Summary of Data Rejected During V&V

Analyte Group	Matrix	Total No. of Rejected Records	Total No. of Records	Percent Rejected (%)
Dioxins and Furans	WATER	0	14	0.00
Herbicide	SOIL	2	138	1.45
Herbicide	WATER	7	153	4.58
Metal	SOIL	105	8,678	1.21
Metal	WATER	391	20,280	1.93
PCB	WATER	0	196	0.00
Pesticide	SOIL	17	138	12.32
Pesticide	WATER	1	901	0.11
Radionuclide	SOIL	252	1,707	14.76
Radionuclide	WATER	575	6,071	9.47
SVOC	SOIL	84	8,169	1.03
SVOC	WATER	52	1,988	2.62
VOC	SOIL	153	5,781	2.65
VOC	WATER	862	25,399	3.39
Wet Chem	SOIL	8	484	1.65
Wet Chem	WATER	122	3,853	3.17
	Total	**2,631**	**83,950**	**3.13%**

Table A2.7
Summary of RPDs/DERs of Field Duplicate Analyte Pairs

Analyte Group	Matrix	No. of Duplicates Failing RPD/DER Criteria	Total No. of Duplicate Pairs	Percent Failure (%)	Field Duplicate Frequency (%)
Metal	SOIL	4	169	2.37	4.41
Metal	WATER	43	2,209	1.95	13.83
Radionuclide	SOIL	0	34	0.00	4.70
Radionuclide	WATER	1	628	0.16	13.84
Wet Chem	SOIL	2	9	22.22	3.91
Wet Chem	WATER	7	361	1.94	13.46

Table A2.8
Summary of Data Estimated or Undetected Due to V&V Determinations

Analyte Group	Matrix	No. of CRA Data Records Qualified	Total No. of V&V CRA Records	Detect?	Percent Qualified (%)
Herbicide	WATER	5	142	No	3.52
Metal	SOIL	518	3,834	No	13.51
Metal	SOIL	555	3,834	Yes	14.48
Metal	WATER	2,040	14,368	No	14.20
Metal	WATER	777	14,368	Yes	5.41
PCB	WATER	56	175	No	32.00
Pesticide	WATER	217	836	No	25.96
Radionuclide	SOIL	1	689	Yes	0.15
Radionuclide	WATER	29	3,830	No	0.76
Radionuclide	WATER	82	3,830	Yes	2.14
SVOC	SOIL	30	3,237	No	0.93
SVOC	WATER	133	1,758	No	7.57
VOC	SOIL	35	2,314	No	1.51
VOC	SOIL	3	2,314	Yes	0.13
VOC	WATER	378	17,512	No	2.16
VOC	WATER	14	17,512	Yes	0.08
Wet Chem	SOIL	10	230	No	4.35
Wet Chem	SOIL	58	230	Yes	25.22
Wet Chem	WATER	118	2,417	No	4.88
Wet Chem	WATER	157	2,417	Yes	6.50
	Total	**5,216**	**51,456**		**10.14%**

Table A2.9
Summary of Data Qualified as Undetected Due to Blank Contamination

Analyte Group	Matrix	No. of CRA Records Qualified as Undetected	Total No. of CRA Records with Detected Results[a]	Percent Qualified as Undetected
Metal	SOIL	17	2,749	0.62
Metal	WATER	30	5,580	0.54
	Total	**47**	**8,329**	**0.56%**

[a] As determined by the laboratory prior to V&V.

COMPREHENSIVE RISK ASSESSMENT

INTER-DRAINAGE EXPOSURE UNIT

VOLUME 5: ATTACHMENT 3

Statistical Analyses and Professional Judgment

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ACRONYMS AND ABBREVIATIONS

COC	contaminant of concern
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
ECOI	ecological contaminant of interest
EcoSSL	Ecological Soil Screening Level
ECOPC	ecological contaminant of potential concern
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESL	ecological screening level
EU	Exposure Unit
HHRA	Human Health Risk Assessment
IDEU	Inter-Drainage Exposure Unit
MDC	maximum detected concentration
mg/kg	milligrams per kilogram
NCP	National Contingency Plan
NOAEL	no observed adverse effect level
PMJM	Preble's meadow jumping mouse
PRG	preliminary remediation goal
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
tESL	threshold ESL
UCL	upper confidence limit
UTL	upper tolerance limit

WRS	Wilcoxon Rank Sum
WRW	wildlife refuge worker

1.0 INTRODUCTION

This attachment presents the results for the statistical analyses and professional judgment evaluation used to select human health contaminants of concern (COCs) as part of the Human Health Risk Assessment (HHRA) and ecological contaminants of potential concern (ECOPCs) as part of the Ecological Risk Assessment (ERA) for the Inter-Drainage Exposure Unit (EU) (IDEU) at the Rocky Flats Environmental Technology Site (RFETS). The methods used to perform the statistical analysis and to develop the professional judgment sections are described in Appendix A, Volume 2, Section 2 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report).

2.0 RESULTS OF STATISTICAL COMPARISONS TO BACKGROUND FOR THE INTER-DRAINAGE EXPOSURE UNIT

The results of the statistical background comparisons for inorganic and radionuclide potential contaminants of concern (PCOCs) and ecological contaminants of interest (ECOIs) in surface soil/surface sediment, subsurface soil/subsurface sediment, surface soil, and subsurface soil samples collected from the IDEU are presented in this section. Box plots are provided for analytes that were carried forward into the statistical comparison step and are presented in Figures A3.2.1 to A3.2.26.[1] The box plots display several reference points: 1) the line inside the box is the median; 2) the lower edge of the box is the 25th percentile; 3) the upper edge of the box is the 75th percentile; 4) the upper lines (called whiskers) are drawn to the greatest value that is less than or equal to 1.5 times the inter-quartile range (the interquartile range is between the 75th and 25th percentiles); 5) the lower whiskers are drawn to the lowest value that is greater than or equal to 1.5 times the inter-quartile range; and 6) solid circles are data points greater or less than the whiskers.

ECOIs for surface soil (Preble's meadow jumping mouse [PMJM] receptor) and PCOCs with concentrations in the IDEU that are statistically greater than background (or those where background comparisons were not performed) are carried through to the professional judgment step of the COC/ECOPC selection processes. ECOIs (for non-PMJM receptors) with concentrations in the IDEU that are statistically greater than background (or those where background comparisons were not performed) are carried

[1] Statistical background comparisons are not performed for analytes if: 1) the background concentrations are nondetections; 2) background data are unavailable; 3) the analyte has low detection frequency in the IDEU or background data set (less than 20 percent); or 4) the analyte is an organic compound. Box plots are not provided for these analytes. However, these analytes are carried forward into the professional judgment evaluation.

through to the upper-bound exposure point concentration (EPC) – threshold ecological screening level (tESL) comparison step of the ECOPC selection processes.

PCOCs and ECOIs with concentrations that are not statistically greater than background are not identified as COCs/ECOPCs and are not evaluated further.

2.1 Surface Soil/Surface Sediment Data Used in the HHRA

For the IDEU surface soil/surface sediment data set, the maximum detected concentrations (MDCs) and upper confidence limits on the mean (UCLs) for arsenic exceed the wildlife refuge worker (WRW) preliminary remediation goals (PRGs), and this PCOC was carried forward into the statistical background comparison step. The results of the statistical comparison of the IDEU surface soil/surface sediment data to background data for these PCOCs are presented in Table A3.2.1 and the summary statistics for background and IDEU surface soil/surface sediment data are shown in Table A3.2.2. The IDEU MDC for aluminum and manganese exceed the PRG, but the UCL for the IDEU data set does not exceed the PRG, and these analytes were not evaluated further. The MDC and UCL for arsenic exceed the PRG and was carried forward into the statistical background comparison step.

The results of the statistical comparisons of the IDEU surface soil/surface sediment data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Arsenic

Not Statistically Greater than Background at the 0.1 Significance Level

- None

Background Comparison Not Performed[/]

- None

2.2 Subsurface Soil/Subsurface Sediment Data Used in the HHRA

The MDC and UCL for radium-228 exceed the PRG for the IDEU subsurface soil/subsurface sediment data set and was carried forward into the statistical background comparison step. The results of the statistical comparison of the IDEU subsurface soil/subsurface sediment data to the background data are presented in Table A3.2.3 and the summary statistics for the IDEU subsurface soil/subsurface sediment data to background data are presented in Table A3.2.4.

The results of the statistical comparisons of the IDEU subsurface soil/subsurface data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- None

Not Statistically Greater than Background at the 0.1 Significance Level

- Radium-228

Background Comparison not Performed[1]

- None

2.3 Surface Soil Data Used in the ERA (Non-PMJM Receptors)

For the ECOIs in surface soil, the MDCs for aluminum, antimony, arsenic, barium, boron, cadmium, chromium, copper, lead, lithium, manganese, mercury, molybdenum, nickel, tin, vanadium, and zinc exceed a non-PMJM ESL, and these ECOIs were carried forward into the statistical background comparison step. The results of the statistical comparison of the IDEU surface soil data to background data are presented in Table A3.2.5 and the summary statistics for background and IDEU surface soil data are shown in Table A3.2.6.

The results of the statistical comparisons of the IDEU surface soil to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Aluminum
- Arsenic
- Barium
- Chromium
- Lead
- Lithium
- Manganese

Not Statistically Greater than Background at the 0.1 Significance Level

- Cadmium
- Copper
- Mercury
- Nickel
- Vanadium
- Zinc

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Background Comparison not Performed[1]

- Antimony
- Boron
- Molybdenum
- Tin

2.4 Surface Soil Data used in the ERA (PMJM Receptors)

For the ECOIs in surface soil in PMJM habitat, the MDCs for arsenic, manganese, nickel, selenium, vanadium, and zinc exceed the PMJM ESLs, and were carried forward into the background comparison step. The results of the statistical comparison of the IDEU surface soil data to background data are presented in Table A3.2.7 and the summary statistics for background and IDEU surface soil data are shown in Table A3.2.8.

The results of the statistical comparisons of the IDEU surface soil in PMJM habitat to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- None

Not Statistically Greater than Background at the 0.1 Significance Level

- Arsenic
- Manganese
- Nickel
- Selenium
- Vanadium
- Zinc

Background Comparison not Performed[1]

- None

2.5 Subsurface Soil Data used in the ERA

For the ECOIs in subsurface soil, the MDC for arsenic, mercury, nickel, and vanadium exceed the prairie dog ESL and were carried forward into the statistical background comparison step. The MDCs for all other ECOIs do not exceed the prairie dog ESL. The results of the statistical comparison of the IDEU subsurface soil data to background data

are presented in Table A3.2.9 and the summary statistics for background and IDEU subsurface soil data are shown in Table A3.2.10.

The results of the statistical comparisons of the surface soil data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- None

Not Statistically Greater than Background at the 0.1 Significance Level

- Arsenic
- Nickel
- Vanadium

Background Comparison not Performed[/]

- Mercury

3.0 UPPER-BOUND EXPOSURE POINT CONCENTRATION COMPARISON TO LIMITING ECOLOGICAL SCREENING LEVELS

ECOIs in surface soil and subsurface soil with concentrations that are statistically greater than background, or if background comparisons were not performed, are evaluated further by comparing the IDEU EPCs to the limiting threshold (tESLs). The EPCs are the 95 percent UCLs of the 90th percentile [upper tolerance limit (UTL)] for small home-range receptors, the UCL for large home-range receptors, or the MDC in the event that the UCL or UTL is greater than the MDC.

3.1 ECOIs in Surface Soil

Barium, manganese and molybdenum in surface soil (non-PMJM) were eliminated from further consideration because the upper-bound EPCs are not greater than the tESLs. Aluminum, antimony, arsenic, boron, chromium, lead, lithium, and tin have upper-bound EPCs greater than the tESLs and are evaluated in the professional judgment evaluation screening step (Section 4.0).

3.2 ECOIs in Subsurface Soil

Mercury in subsurface soil was eliminated from further consideration because the upper-bound EPC is not greater than the tESL. There are no analytes carried forward into professional judgment for subsurface soils.

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4.0 PROFESSIONAL JUDGMENT

This section presents the results of the professional judgment step of the COC and ECOPC selection processes for the HHRA and ERA, respectively. Based on the weight of evidence evaluated in the professional judgment step, PCOCs and ECOIs are either included for further evaluation as COCs/ECOPCs in the risk characterization step, or excluded from further evaluation.

The professional judgment evaluation takes into account the following lines of evidence: process knowledge, spatial trends, pattern recognition[2], comparison to RFETS background and regional background data sets (see Table A3.4.11 for a summary of regional background data)[3], and risk potential. For PCOCs or ECOIs where the process knowledge and/or spatial trends indicate that the presence of the analyte in the EU may be a result of historical site-related activities, the professional judgment discussion includes only two of the lines of evidence listed above, and it is concluded that these analytes are COCs/ECOPCs and are carried forward into risk characterization. For the other PCOCs and ECOIs that are evaluated in the professional judgment step, each of the lines of evidence listed above are included in the discussion.

For metals, Appendix A, Volume 2, Attachment 8 of the RI/FS Report provides the details of the process knowledge and spatial trend evaluations. The conclusions from these evaluations are noted in this attachment.

The following PCOCs/ECOIs are evaluated further in the professional judgment step for IDEU:

- Surface soil/surface sediment (HHRA)
  - Arsenic

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[2] The pattern recognition evaluation includes the use of probability plots. If two or more distinct populations are evident in the probability plot, this suggests that one or more local releases may have occurred. Conversely, if only one distinct low-concentration population is defined, likely representing a background population, a local release may or may not have occurred. Similar to all statistical methods, the probability plot has limitations in cases where there is inadequate sampling and the magnitude of the release is relatively small. Thus, absence of two clear populations in the probability plots is consistent with, but not definitive proof of, the hypothesis that no releases have occurred. However, if a release has occurred within the sampled area and has been included in the samples, then the elemental concentrations associated with that release are either within the background concentration range or the entire sampled population represents a release, a highly unlikely probability.

[3] The regional background data set for Colorado and the bordering states was extracted from data for the western United States (Shacklette and Boerngen 1984), and is composed of data from Colorado as well as Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming. Although the Colorado and bordering states background data set is not specific to Colorado's Front Range, it is useful for the professional judgment evaluation in the absence of a robust data set for the Front Range. Colorado's Front Range has highly variable terrain that changes elevation over short distances. Consequently, numerous soil types and geologic materials are present at RFETS, and the data set for Colorado and bordering states may be more representative of these variable soil types.

- Subsurface soil/subsurface sediment (HHRA)
  - No PCOCs were found to be statistically greater than background and above a PRG in accordance with the COC selection process; therefore, no PCOCs in subsurface soil/subsurface sediment are evaluated using professional judgment.
- Surface soil for non-PMJM receptors (ERA)
  - Aluminum
  - Antimony
  - Arsenic
  - Boron
  - Chromium
  - Lead
  - Lithium
  - Tin
- Surface soil for PMJM receptors (ERA)
  - No ECOIs were found to be statistically greater than background and above an ESL in accordance with the ECOPC selection process; therefore, no ECOIs in subsurface soil are evaluated using professional judgment.
- Subsurface soil (ERA)
  - No ECOIs were found to be statistically greater than background and above an ESL in accordance with the ECOPC selection process; therefore, no ECOIs in subsurface soil are evaluated using professional judgment

The following sections provide the professional judgment evaluations, by analyte and by medium, for the PCOCs/ECOIs listed above.

4.1 Aluminum

Aluminum has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if aluminum should be retained for risk characterization are summarized below.

4.1.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates aluminum to be a potential to have been released into the RFETS soil because of the aluminum metal inventory and presence of aluminum in waste generated during former operations. However, the localized document sources are remote from the IDEU.

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4.1.2 Evaluation of Spatial Trends

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that aluminum concentrations in IDEU surface soil reflect variations in naturally occurring aluminum.

4.1.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for aluminum indicates a single background population ranging from 7,340 to 19,400 mg/kg, but with three apparently anomalously high concentration samples. These samples suggest a higher clay content in these three samples than those representing the background population (Figure A3.4.1).

4.1.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

Aluminum concentrations in IDEU surface soil range from 7,340 to 35,000 mg/kg with a mean concentration of 13,234 mg/kg and a standard deviation of 5,151 mg/kg. Aluminum concentrations in the background data set range from 4,050 to 17,100 mg/kg with a mean concentration of 10,203 mg/kg and a standard deviation of 3,256 mg/kg (Table A3.2.6). The maximum concentrations of aluminum in surface soil samples at the IDEU are elevated compared to background but the data populations overlap considerably.

Aluminum concentrations IDEU surface soil are well within the range for aluminum in soils of Colorado and the bordering states (5,000 to 100,000 mg/kg, with a mean concentration of 50,800 mg/kg and a standard deviation of 23,500 mg/kg) (Table A3.4.1).

4.1.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The MDC for aluminum in the IDEU (35,000 mg/kg) exceeds the NOAEL ESL for only one receptor group, terrestrial plants (50 mg/kg). However, EPA ecological soil screening level (EcoSSL) guidance (EPA 2003) for aluminum recommends that aluminum should not be considered an ECOPC for soils at sites where the soil pH exceeds 5.5 due to its limited bioavailability in non-acidic soils. The average pH value for RFETS surface soils is 8.2. Therefore, aluminum concentrations in IDEU surface soil are unlikely to result in risk concerns for wildlife populations.

4.1.6 Conclusion

The weight of evidence presented above shows that aluminum concentrations in IDEU surface soil (non-PMJM receptors) are not likely to be a result of historical site-related activities based on process knowledge, have a spatial distribution and single data population indicative of naturally occurring aluminum, are well within regional background levels, and are unlikely to result in risk concerns for wildlife populations. Aluminum is not considered an ECOPC in surface soil for the IDEU and, therefore, is not further evaluated quantitatively.

4.2 Antimony

Antimony has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if antimony should be retained for risk characterization are summarized below.

4.2.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates antimony is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.2.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, several locations have antimony concentrations in IDEU that are greater than the ESL and the background MDC that are located near a historical IHSS.

4.2.3 Conclusion

Antimony in surface soil is being carried forward into the ecological non-PMJM risk characterization because of elevated concentrations (greater than three times the ESL), and because antimony is at nondetectable concentrations for the background data set. Antimony was used in limited quantities during historical RFETS operations, which would indicate that it is unlikely to be a site-related contaminant. Nevertheless, as a conservative measure, antimony is carried forward into the risk characterization recognizing that the classification as a COC/ECOPC is uncertain.

4.3 Arsenic

Arsenic has concentrations statistically greater than background in surface soil/surface sediment and, therefore, was carried forward to the professional judgment step. Arsenic also has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of

evidence used to determine if arsenic should be retained for risk characterization are summarized below.

4.3.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates arsenic is unlikely to be present in IDEU soil as a result of historical site-related activities.

4.3.2 Evaluation of Spatial Trends

Surface Soil/Surface Sediment

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that arsenic concentrations in IDEU surface soil/surface sediment reflect variations in naturally occurring arsenic.

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that arsenic concentrations in IDEU subsurface soil reflect variations in naturally occurring arsenic.

4.3.3 Pattern Recognition

Surface Soil/Surface Sediment

The probability plot for arsenic indicates a single background population ranging from about 4.0 to 9.0 mg/kg but with four apparently anomalously high samples (Figure A3.4.2).

Surface Soil (Non-PMJM)

The probability plot for arsenic indicates a single background population ranging from 4.0 to 9.0 mg/kg but with four apparently anomalously high samples (Figure A3.4.3). The following table lists the four samples and their respective arsenic concentrations.

4.3.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil/Surface Sediment

Arsenic concentrations in IDEU surface soil/surface sediment range from 4.00 to 17.0 mg/kg with a mean concentration of 7.78 mg/kg and a standard deviation of 1.90 mg/kg. Arsenic concentrations in the background data set range from 0.27 to 9.60 mg/kg with a mean concentration of 3.42 mg/kg and a standard deviation of 2.55 mg/kg (Table A3.2.2). The range of concentrations of arsenic in the IDEU and background samples overlap considerably with only four of the 64 detections greater than the background MDC (9.6 mg/kg).

Arsenic concentrations IDEU surface soil/surface sediment are well within the range for arsenic in soils of Colorado and the bordering states (1.22 to 97 mg/kg, with a mean concentration of 6.9 mg/kg and a standard deviation of 7.64 mg/kg) (Table A3.4.1).

Surface Soil (Non-PMJM)

Arsenic concentrations in IDEU surface soil range from 4.00 to 17.0 mg/kg with a mean concentration of 7.78 mg/kg and a standard deviation of 1.90 mg/kg. Arsenic concentrations in the background data set range from 2.30 to 9.60 mg/kg with a mean concentration of 6.09 mg/kg and a standard deviation of 2.00 mg/kg (Table A3.2.6). The range of concentrations of arsenic in the IDEU and background samples overlap considerably with only four of the 64 detections greater than the background MDC (9.6 mg/kg).

Arsenic concentrations IDEU surface soil are well within the range for arsenic in soils of Colorado and the bordering states (1.22 to 97 mg/kg, with a mean concentration of 6.9 mg/kg and a standard deviation of 7.64 mg/kg) (Table A3.4.1).

4.3.5 Risk Potential for HHRA

Surface Soil/Surface Sediment

The arsenic MDC for surface soil/surface sediment is 17.0 mg/kg and the UCL is 8.18 mg/kg. The UCL is less than three times greater than the PRG (2.41 mg/kg), with all of the 64 detections greater than the PRG. Because the PRG is based on an excess carcinogenic risk of 1E-06, the cancer risk based on the UCL concentration is less than 3E-06, and is well within the National Contingency Plan (NCP) risk range of 1E-06 to 1E-04. Arsenic is detected in 67 of 73 background samples, and concentrations in 39 of the 67 samples with detects exceed the PRG. The background UCL for arsenic in surface soil/surface sediment is 4.03 mg/kg (Appendix A, Volume 2, Attachment 9 of the RI/FS Report), which equates to a cancer risk of 2E-06. Therefore, the excess cancer risks to the WRW from exposure to arsenic in surface soil/surface sediment in the IDEU are similar to background risk.

4.3.6 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for arsenic in IDEU (12.0 mg/kg) surface soil (for non-PMJM receptors) exceeds the NOAEL ESL for terrestrial plants (10 mg/kg), deer mouse herbivore (2.57 mg/kg), and prairie dog (9.35 mg/kg). The ESLs for deer mouse herbivore and prairie dog are less than the MDC for background surface soil concentrations. Because risks are not typically expected at background concentrations, these ESLs may be overly conservative, and arsenic is unlikely to result in risk concerns for wildlife populations in excess of those likely to be found in background areas.

4.3.7 Conclusion

The weight of evidence presented above shows that arsenic concentrations in IDEU surface soil/surface sediment and surface soil (non-PMJM receptors) are not likely to be a result of historical site-related activities based on process knowledge, have a spatial distribution and single data population indicative of naturally occurring arsenic, and are well within regional background levels. Arsenic is not considered a COC in surface soil/surface sediment or an ECOPC in surface soil (non-PMJM receptors) for the IDEU and, therefore, is not further evaluated quantitatively.

4.4 Boron

Boron has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if boron should be retained for risk characterization are summarized below.

4.4.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates boron is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.4.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that boron concentrations in IDEU surface soil reflect variations in naturally occurring boron.

4.4.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for boron concentrations indicates a single background population (Figure A3.4.4).

4.4.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

The reported range for boron in surface soil within Colorado and the bordering states is 20 to 150 mg/kg, with a mean concentration of 27.9 mg/kg and a standard deviation of 19.7 mg/kg. Boron concentrations reported in surface soil samples at the IDEU range from 4.30 to 9.70 mg/kg with a mean concentration of 5.64 mg/kg and a standard

deviation of 2.19 mg/kg (Table A3.2.6). The range of concentrations of boron in surface soil is well within the range for boron in soils of Colorado and the bordering states.

4.4.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The MDC for boron in the IDEU (9.70 mg/kg) exceeds the NOAEL ESL for only one receptor group, terrestrial plants (0.5 mg/kg). All other NOAEL ESLs were greater than the MDC and ranged from 30.3 to 6,070 mg/kg. Site-specific background data for boron were not available, but the MDC did not exceed the low end (20 mg/kg) of the background range presented in Table A3.4.1. This indicates the terrestrial plant NOAEL ESL (0.5 mg/kg) is well below expected background concentrations, and MDCs above the NOAEL ESL are not likely to be indicative of site-related risk to the terrestrial plant community in the IDEU. Kabata-Pendias and Pendias (1992) indicate soil with boron concentrations equal to 0.3 mg/kg is critically deficient in boron, and effects on plant reproduction would be expected. Additionally, the summary of boron toxicity in Efroymson et al. (1997) notes that the source of the 0.5-mg/kg NOAEL ESL indicates boron was toxic when added at 0.5 mg/kg to soil, but gives no indication of the boron concentration in the baseline soil before addition. The confidence placed by Efroymson et al. (1997) was low. Because no NOAEL ESLs other than the terrestrial plant NOAEL ESL are exceeded by the MDC, boron is highly unlikely to present a risk to terrestrial receptor populations in the IDEU.

4.4.6 Conclusion

The weight of evidence presented above shows that boron concentrations in IDEU surface soil (non-PMJM receptors) are not likely to be a result of historical site-related activities based on process knowledge, have a spatial distribution and single data population indicative of naturally occurring boron, are well within regional background levels, and are unlikely to result in risk concerns for wildlife populations. Boron is not considered an ECOPC in surface soil for the IDEU and, therefore, is not further evaluated quantitatively.

4.5 Chromium

Chromium has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if chromium should be retained for risk characterization are summarized below.

4.5.1 Summary of Process Knowledge

Based on process knowledge as detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the potential for chromium to be a COC in the IDEU is low due to a moderate inventory, and limited identification as a constituent in wastes generated at RFETS and localized documented historical source areas remote from the IDEU.

4.5.2 Evaluation of Spatial Trends

Surface Soil (non-PMJM)

Based on the spatial trend evaluation detailed in Attachment 8 of Volume 2, chromium concentrations in the IDEU appear to be variations of naturally occurring conditions.

4.5.3 Pattern Recognition

Surface Soil (non-PMJM)

The probability plot for chromium indicates two populations: a background population ranging from 9.3 to 12.7 mg/kg and a second population ranging from 13.1 to 26 mg/kg. The samples in this second population need to be compared with the geology and soils to see if they represent a background population for a lithological difference in these 29 samples. Chromium is closely associated with the aluminum concentration and may reflect the amount of clay in the samples. These samples may contain more clay than the lower concentration population, but may still represent a background population (Figure A3.4.5).

4.5.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

Chromium concentrations in surface soil samples at the IDEU range from 9.30 to 26.0 mg/kg with a mean concentration of 13.7 mg/kg and a standard deviation of 3.83 mg/kg. Chromium concentrations in the background data set range from 5.50 to 16.9 mg/kg with a mean concentration of 11.2 mg/kg and a standard deviation of 2.78 mg/kg (Table A3.2.6). The maximum concentrations of chromium in surface soil samples at the IDEU are elevated compared to background but the data populations do overlap considerably.

Chromium concentrations reported in surface soil samples at the IDEU are well within the range for chromium in soils of Colorado and the bordering states (3 to 500 mg/kg with mean concentration of 48.2 mg/kg and a standard deviation of 41 mg/kg) (Table A3.4.1).

4.5.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for chromium in the IDEU (22.7 mg/kg) exceeds the NOAEL ESL for terrestrial plants (1 mg/kg), terrestrial invertebrates (0.4 mg/kg), mourning dove insectivore (1.34 mg/kg), and American Kestrel (14.0 mg/kg). All of these ESLs are less than the MDC in background surface soils. All other NOAEL ESLs were greater than the UTL and ranged from 68.5 to 4,170 mg/kg. The chromium ESLs are based on toxicity to hexavalent chromium, of which is likely to represent only a small fraction of the total chromium detected in soils. The mammalian ESLs for trivalent chromium are

considerably greater than the hexavalent chromium ESLs. This indicates that the ESL based on hexavalent chromium may be overly conservative for use in assessing risk to the PMJM.

4.5.6 Conclusion

The weight of evidence presented above shows that chromium concentrations in IDEU surface soil (non-PMJM receptors) are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact chromium concentrations in surface soil. Chromium is not considered an ECOPC in surface soil for the IDEU and is not further evaluated quantitatively.

4.6 Lead

Lead has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if lead should be retained for risk characterization are summarized below.

4.6.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates lead was used in relatively large quantities, but was extremely limited in scope or duration. Lead waste was generated in both laboratory and process wastes.

4.6.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that lead concentrations in IDEU surface soil cannot be eliminated as an ECOPC for the IDEU because lead concentrations in surface soil are greater than the minimum ESL and greater than the background MDC at locations near historical IHSSs.

4.6.3 Conclusion

Lead in surface soil is being carried forward into the ecological non-PMJM risk characterization because of elevated concentrations (greater than 3 times the ESL) and because lead waste was generated in both laboratory and process buildings. Lead was used in large quantities during historical RFETS operations, but in extremely limited scope or duration. Therefore, as a conservative measure, lead is carried forward into the risk characterization recognizing that their classification as COCs/ECOPCs is uncertain.

4.7 Lithium

Lithium had an upper-bound exposure point concentration (EPC) in surface soil (for non-PMJM receptors) greater than the limiting threshold ecological screening level (tESL) so was carried forward to the professional judgment step. The lines of evidence used to determine if lithium should be retained as a COC are summarized below.

4.7.1 Summary of Process Knowledge

Based on process knowledge as detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the potential for lithium to be a COC in the IDEU is low due to a small inventory, no record of spills, limited identification as a constituent in wastes generated at RFETS and localized documented historical source areas remote from the IDEU.

4.7.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Based on the spatial trend evaluation detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, lithium concentrations in the IDEU appear to be variations of naturally occurring conditions.

4.7.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for lithium concentrations indicates a single background population (Figure A3.4.6).

4.7.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

Lithium concentrations in surface soil samples at the IDEU range from 5.50 to 19.4 mg/kg with a mean concentration of 10.2 mg/kg and a standard deviation of 2.94 mg/kg. Lithium concentrations in the background data set range from 4.80 to 11.6 mg/kg with a mean concentration of 7.66 mg/kg and a standard deviation of 1.89 mg/kg (Table A3.2.6). The maximum concentrations of lithium in surface soil samples at the IDEU are elevated compared to background but the data populations do overlap considerably.

Lithium concentrations reported in surface soil samples at the IDEU are well within the range for lithium in soils of Colorado and the bordering states (5 to 130 mg/kg with mean concentration of 25.3 mg/kg and a standard deviation of 14.4 mg/kg) (Table A3.4.1).

4.7.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for lithium in the IDEU (16.0 mg/kg) exceeds the NOAEL ESL for only one receptor group, terrestrial plants (2 mg/kg). All other NOAEL ESLs were greater than the UTL and ranged from 610 to 18,400 mg/kg. The ESL for terrestrial plants is lower than all detected background concentrations. Since risks to ecological receptors are not expected at background concentrations, the terrestrial plant ESL may be overly-conservative.

4.7.6 Conclusion

The weight of evidence presented above shows that lithium concentrations in surface soil in the IDEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact lithium concentrations in surface soil. In addition, the maximum concentrations of lithium in surface soil samples at the IDEU are elevated compared to background but the data populations do overlap considerably. Lithium is not considered an ECOPC in surface soil for the IDEU and is not further evaluated quantitatively.

4.8 Tin

Tin had an upper-bound exposure point concentration (EPC) in surface soil (for non-PMJM receptors) greater than the limiting threshold ecological screening level (tESL) so was carried forward to the professional judgment step per the CRA methodology. The lines of evidence used to determine if tin should be retained as a COC are summarized below.

4.8.1 Summary of Process Knowledge

Based on process knowledge as detailed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the potential for tin to be a COC in the IDEU is low due to localized documented historical source areas remote from the IDEU.

4.8.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Based on the spatial trend evaluation detailed in Attachment 8 of Volume 2, tin concentrations in the IDEU appear to be variations of naturally occurring conditions.

4.8.3 Pattern Recognition

Surface Soil (Non-PMJM)

Figure A3.4.7 is a probability plot that contains both the detected and nondetected tin concentrations in the 64 soil samples from this EU, while Figure A3.4.8 contains only the

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14 samples with detected concentrations. Both appear to represent a single background population, but the summary statistics for the IDEU tin concentration are considerably different. If nondetects are included, the IDEU tin concentration ranges from 0.84 to 6.9 mg/kg with a mean and standard deviation of 2.92 and 1.10 mg/kg, respectively. However, if only the detected concentrations are used, the IDEU tin concentrations range from 2.4 to 4.9 mg/kg with a mean and standard deviation of 3.34 and 0.82 mg/kg, respectively.

4.8.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

The reported range for tin in surface soil within Colorado and the bordering states is 0.117 to 5.001 mg/kg with a mean concentration of 1.15 mg/kg and a standard deviation of 0.772 mg/kg (Table A3.4.1). Tin concentrations reported in surface soil samples at the IDEU are 2.40 to 4.90 mg/kg with a mean concentration of 1.82 mg/kg and a standard deviation of 1.02 mg/kg (Table A3.2.6). The range of concentrations of tin in surface soil is within the range for tin in soils of Colorado and the bordering states (Table A3.2.6).

4.8.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for tin in the IDEU (4.10 mg/kg) exceeds the NOAEL ESL for two receptor groups: mourning dove insectivore (2.90 mg/kg), and deer mouse insectivore (3.77 mg/kg). All other NOAEL ESLs were greater than the UTL and ranged from 16.2 to 242 mg/kg. None of the ESLs are within the range of background concentrations and are not likely to be overly conservative for use in screening level risk assessments.

4.8.6 Conclusion

The weight of evidence presented above shows that tin concentrations in surface soil in the IDEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. There is no evidence of a release from potential sources inside or outside the EU that would impact tin concentrations in surface soil. Tin is not considered an ECOPC in surface soil for the IDEU and is not further evaluated quantitatively.

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TABLES

Table A3.2.1
Statistical Distribution and Comparison to Background for IDEU Surface Soil/ Surface Sediment

	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Data Set			IDEU Data Set (excluding background samples)					
Analyte	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Statistically Greater than Background?
Arsenic	73	GAMMA	91.8	64	NONPARAMETRIC	100.00	WRS	0.00E+00	Yes

WRS = Wilcoxon Rank Sum Text

Bold = PCOCs retained for further consideration in the next COC selection step.

Table A3.2.2

Summary Statistics for Background and IDEU Surface Soil/Surface Sediments[a]

Analyte	Units	Background					IDEU (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean	Standard Deviation
Arsenic	mg/kg	73	0.270	9.60	3.42	2.55	64	4.00	17.0	7.78	1.90

[a] Statistics are computed using one-half of the reported values for nondetects.

Table A3.2.3
Statistical Distribution and Comparison to Background for IDEU Subsurface Soil/Subsurface Sediment

	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Data Set			IDEU Data Set (excluding background samples)					
Analyte	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Statistically Greater than Background?
Radium-228	31	GAMMA	100.0	4	NORMAL	100.00	WRS	0.960	No

WRS = Wilcoxon Rank Sum Text
Bold = PCOCs retained for further consideration in the next COC selection step.

Table A3.2.4
Summary Statistics for Background and IDEU Subsurface Soil/Subsurface Sediments

		Background					IDEU (excluding background samples)				
Analyte	Units	Total Samples	Minimum Detected Concentration	Maximum	Mean	Standard Deviation	Total Samples	Minimum	Maximum	Mean	Standard Deviation
Radium-228	pCi/g	31	1.00	2.10	1.45	0.320	4	0.890	1.35	1.00	0.193

* Statistics note note

Table A3.2.5
Statistical Distribution and Comparison to Background for IDEU Surface Soil (non-PMJM)

	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Data Set			IDEU Data Set (excluding background samples)					
Analyte	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Statistically Greater than Background?
Aluminum	20	NORMAL	100.0	64	NONPARAMETRIC	100.00	WRS	0.005	Yes
Antimony	20	NONPARAMETRIC	0.0	64	NONPARAMETRIC	14.06	N/A	N/A	N/A
Arsenic	20	NORMAL	100.0	64	NONPARAMETRIC	100.00	WRS	7.40E-04	Yes
Barium	20	NORMAL	100.0	64	NONPARAMETRIC	100.00	WRS	3.65E-05	Yes
Boron	N/A	N/A	N/A	14	NORMAL	78.57	N/A	N/A	N/A
Cadmium	20	NONPARAMETRIC	65.0	64	NONPARAMETRIC	42.19	WRS	0.959	No
Chromium	20	NORMAL	100.0	64	NONPARAMETRIC	100.00	WRS	0.008	Yes
Copper	20	NONPARAMETRIC	100.0	64	NONPARAMETRIC	100.00	WRS	0.978	No
Lead	20	NORMAL	100.0	64	NONPARAMETRIC	100.00	WRS	0.010	Yes
Lithium	20	NORMAL	100.0	64	GAMMA	100.00	WRS	1.88E-04	Yes
Manganese	20	NORMAL	100.0	64	NONPARAMETRIC	100.00	WRS	4.03E-04	Yes
Mercury	20	NONPARAMETRIC	40.0	64	NONPARAMETRIC	21.88	WRS	0.998	No
Molybdenum	20	NORMAL	0.0	64	NONPARAMETRIC	37.50	N/A	N/A	N/A
Nickel	20	NORMAL	100.0	64	LOGNORMAL	100.00	WRS	0.759	No
Tin	20	NORMAL	0.0	64	NONPARAMETRIC	21.88	N/A	N/A	N/A
Vanadium	20	NORMAL	100.0	64	NONPARAMETRIC	100.00	WRS	0.123	No
Zinc	20	NORMAL	100.0	64	GAMMA	100.00	WRS	0.998	No

WRS = Wilcoxon Rank Sum Text

N/A = not applicable; site and/or background detection frequency less than 20%.

Bold = PCOCs retained for further consideration in the next COC selection step.

Table A3.2.6

Summary Statistics for Background and IDEU Surface Soil (non PMJM)*

Analyte	Units	Background					IDEU (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean	Standard Deviation
Aluminum	mg/kg	20	4,050	17,100	10,203	3,256	64	7,340	35,000	13,234	5,151
Antimony	mg/kg	20	N/A	N/A	0.279	0.078	64	0.330	3.50	1.39	0.923
Arsenic	mg/kg	20	2.30	9.60	6.09	2.00	64	4.00	17.0	7.78	1.90
Barium	mg/kg	20	45.7	134	102	19.4	64	62.0	199	124	21.8
Boron	mg/kg	N/A	N/A	N/A	N/A	N/A	14	4.30	9.70	5.64	2.19
Cadmium	mg/kg	20	0.670	2.30	0.708	0.455	64	0.600	1.40	0.484	0.363
Chromium	mg/kg	20	5.50	16.9	11.2	2.78	64	9.30	26.0	13.7	3.83
Copper	mg/kg	20	5.20	16.0	13.0	2.58	64	5.30	88.1	13.4	9.87
Lead	mg/kg	20	8.60	53.3	33.5	10.5	64	9.50	82.9	39.9	13.3
Lithium	mg/kg	20	4.80	11.6	7.66	1.89	64	5.50	19.4	10.2	2.94
Manganese	mg/kg	20	129	357	237	63.9	64	45.0	558	300	78.2
Mercury	mg/kg	20	0.090	0.120	0.072	0.031	64	0.009	0.038	0.045	0.014
Molybdenum	mg/kg	20	N/A	N/A	0.573	0.184	64	0.360	2.60	0.768	0.448
Nickel	mg/kg	20	3.80	14.0	9.60	2.59	64	5.10	32.0	9.86	4.50
Tin	mg/kg	20	N/A	N/A	2.06	0.410	64	2.40	4.90	1.82	1.02
Vanadium	mg/kg	20	10.8	45.8	27.7	7.68	64	23.0	71.0	31.1	8.20
Zinc	mg/kg	20	21.1	75.9	49.8	12.2	64	23.0	70.0	42.7	9.12

* Statistics are computed using one-half of the reported values for nondetects.

Table A3.2.7
Statistical Distribution and Comparison to Background for IDEU Surface Soil (PMJM)

	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Data Set			IDEU Data Set (excluding background samples)					
Analyte	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Statistically Greater than Background?
Arsenic	20	NORMAL	100	7	GAMMA	100	WRS	0.925	No
Manganese	20	NORMAL	100	7	NORMAL	100	t-Test_N	0.203	No
Nickel	20	NORMAL	100	7	NORMAL	100	t-Test_N	0.898	No
Selenium	20	NON-PARAMETRIC	60	7	NORMAL	43	WRS	0.994	No
Vanadium	20	NORMAL	100	7	NORMAL	100	t-Test_N	0.621	No
Zinc	20	NORMAL	100	7	LOGNORMAL	100	WRS	0.988	No

WRS = Wilcoxon Rank Sum
t-Test_N = Student's t-test using normal data

Table A3.2.8

Summary Statistics for Background and IDEU Surface Soil (PMJM)[a]

Analyte	Units	Background					IDEU (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean	Standard Deviation
Arsenic	mg/kg	20	2.30	9.60	6.09	2.00	7	1.50	7.60	4.30	2.90
Manganese	mg/kg	20	129	357	237	63.9	7	96.1	556	272	152
Nickel	mg/kg	20	3.80	14.0	9.60	2.59	7	4.50	10.7	8.17	2.14
Selenium	mg/kg	20	0.680	1.40	0.628	0.305	7	0.450	0.580	0.369	0.161
Vanadium	mg/kg	20	10.8	45.8	27.7	7.68	7	11.8	42.0	26.6	9.89
Zinc	mg/kg	20	21.1	75.9	49.8	12.2	7	17.5	138	44.8	42.1

[a] Statistics are computed using one-half of the reported values for nondetects.

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Table A3.2.9
Statistical Distribution and Comparison to Background for IDEU Subsurface Soil

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test Results		
		Background Data Set			IDEU Data Set (excluding background samples)					
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Statistically Greater than Background?
Arsenic	mg/kg	45	NONPARAMETRIC	93.3	72	GAMMA	100.00	WRS	0.544	No
Mercury	mg/kg	41	NONPARAMETRIC	29.3	72	NONPARAMETRIC	19.44	N/A	N/A	N/A
Nickel	mg/kg	44	GAMMA	100.0	72	GAMMA	84.72	WRS	1.000	No
Vanadium	mg/kg	45	NORMAL	97.8	72	NONPARAMETRIC	98.61	WRS	1.000	No

WRS = Wilcoxon Rank Sum
N/A = not applicable; site and/or background detection frequency less than 20%.
WRS = Wilcoxon Rank Sum
t-Test_N = Student's t-test using normal data
N/A = not applicable; site and/or background detection frequency less than 20%.
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table A3.2.10
Summary Statistics for Background and IDEU Subsurface Soil

Analyte	Units	Background					IDEU (excluding background samples)				
		Total Samples	Minimum	Maximum	Mean	Standard Deviation	Total Samples	Minimum	Maximum	Mean	Standard Deviation
Arsenic	mg/kg	45	1.70	41.8	5.48	6.02	72	1.30	16.0	4.79	2.46
Mercury	mg/kg	41	0.190	0.640	0.155	0.166	72	0.047	25.4	0.413	2.99
Nickel	mg/kg	44	4.30	54.2	20.9	11.1	72	1.40	49.0	11.0	7.93
Vanadium	mg/kg	45	11.4	70.0	33.8	14.8	72	6.10	91.9	25.0	13.7

[a] Statistics are computed using one-half of the report values for nondetects.

Table A3.4.1

Summary of Element Concentrations in Colorado and Bordering States Soils

Analyte	Total Number of Results	Number of Nondetects	Detection Frequency (%)	Minimum Detected Value (mg/kg)	Maximum Detected Value (mg/kg)	Range of Detected Values (mg/kg)	Average Detected Value (mg/kg)[c]	Standard Deviation (mg/kg)
Aluminum	335		100%	10.0	100,000	10 - 100,000	45,900	26,900
Antimony	84	71	15%	1.04	2.53	1.038 - 2.531	0.647	0.378
Arsenic	307	2	99%	1.22	97.0	1.224 - 97	6.90	7.64
Barium	342		100%	100	3,000	100 - 3,000	642	330
Beryllium	342	219	36%	1.00	7.00	1 - 7	0.991	0.876
Boron	342	114	67%	20.0	150	20 - 150	27.9	19.7
Bromine	85	42	51%	0.504	3.52	0.5038 - 3.522	0.681	0.599
Calcium	342		100%	0.055	32.0	0.055 - 32	3.09	4.13
Carbon	85		100%	0.300	10.0	0.3 - 10	2.18	1.92
Cerium	291	244	16%	150	300	150 - 300	90.0	38.4
Chromium	342		100%	3.00	500	3 - 500	48.2	41.0
Cobalt	342	39	89%	3.00	30.0	3 - 30	8.09	5.03
Copper	342		100%	2.00	200	2 - 200	23.1	17.7
Fluorine	264	7	97%	10.0	1,900	10 - 1900	394	261
Gallium	340	3	99%	5.00	50.0	5 - 50	18.3	8.90
Germanium	85		100%	0.578	2.15	0.5777 - 2.146	1.18	0.316
Iodine	85	18	79%	0.516	3.49	0.516 - 3.487	1.07	0.708
Iron	342		100%	3,000	100,000	3,000 - 100,000	21,100	13,500
Lanthanum	341	115	66%	30.0	200	30 - 200	39.8	28.8
Lead	342	25	93%	10.0	700	10 - 700	24.8	41.5
Lithium	307		100%	5.00	130	5 - 130	25.3	14.4
Magnesium	342		100%	300	100,000	300 - 100,000	8,890	8,080
Manganese	342		100%	70.0	2,000	70 - 2,000	414	272
Mercury	309	3	99%	0.010	4.60	0.01 - 4.6	0.077	0.276
Molybdenum	340	328	4%	3.00	7.00	3 - 7	1.59	0.522
Neodymium	256	198	23%	70.0	300	70 - 300	47.1	31.7
Nickel	342	12	96%	5.00	700	5 - 700	18.8	39.8
Niobium	335	123	63%	10.0	100	10 - 100	11.4	8.68
Phosphorus	249		100%	40.0	4,497	40 - 4497	399	397
Potassium	341		100%	1,900	63,000	1,900 - 63,000	18,900	6,980
Rubidium	85		100%	35.0	140	35 - 140	75.8	25.0
Scandium	342	51	85%	5.00	30.0	5 - 30	8.64	4.69
Selenium	309	60	81%	0.102	4.32	0.1023 - 4.3183	0.349	0.415
Silicon	85		100%	149,340	413,260	149340 - 413260	302,000	61,500
Sodium	335		100%	500	70,000	500 - 70,000	10,400	6,260
Strontium	342		100%	10.0	2,000	10 - 2,000	243	212
Sulfur	85	71	16%	816	47,760	816 - 47,760	1,250	5,300
Thallium	76		100%	2.45	20.8	2.45 - 20.79	9.71	3.54
Tin	85	3	96%	0.117	5.00	0.117 - 5.001	1.15	0.772
Titanium	342		100%	500	7,000	500 - 7,000	2,290	1,350
Uranium	85		100%	1.11	5.98	1.11 - 5.98	2.87	0.883
Vanadium	342		100%	7.00	300	7 - 300	73.0	41.7
Ytterbium	330	3	99%	1.00	20.0	1 - 20	3.33	2.06
Yttrium	342	7	98%	10.0	150	10 - 150	26.9	18.1
Zinc	330		100%	10.0	2,080	10 - 2,080	72.4	159
Zirconium	342		100%	30.0	1,500	30 - 1,500	220	157

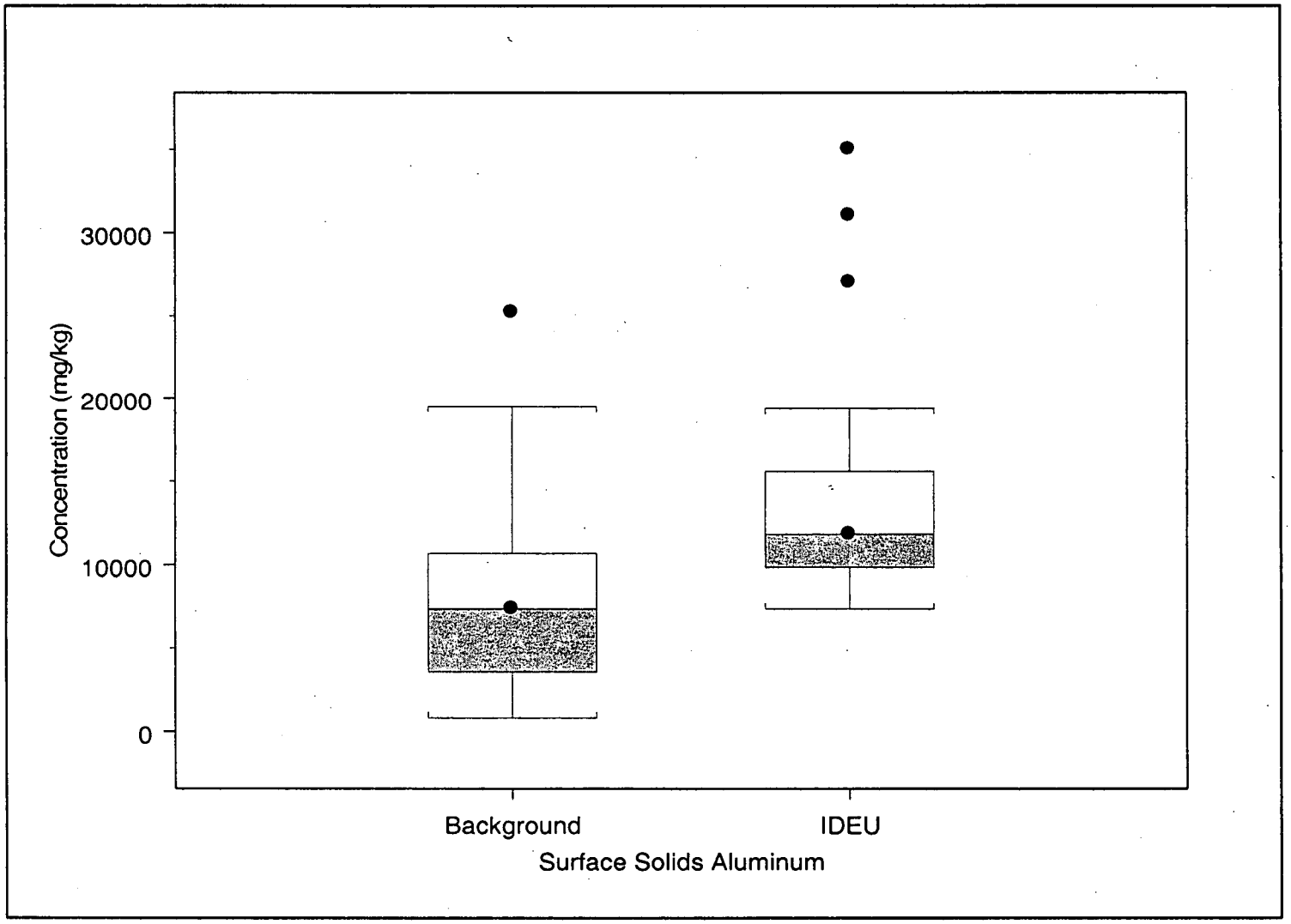
[a] The western U.S. background data set (Shacklette and Boerngen 1984) is composed of background values from Colorado, as well as all states bordering Colorado (Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming). See Section 4.0.

[b] The element was measured at a concentration greater than the upper determination limit for the technique.

[c] Average and standard deviation values were calculated using one-half the reported value for nondetects.

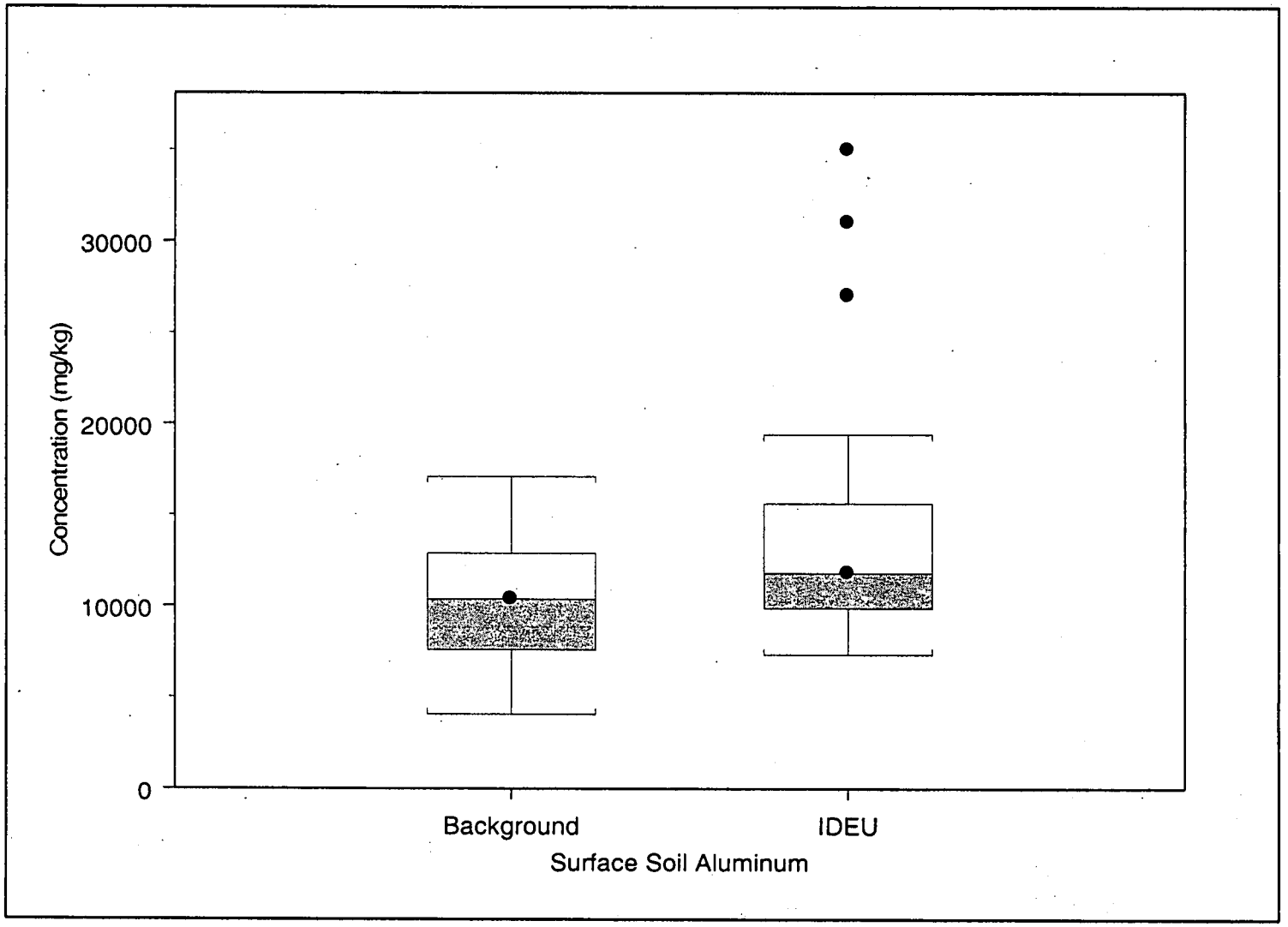
FIGURES

Figure 3.2.1
IDEU Surface Soil/Surface Sediment Box Plots for Aluminum



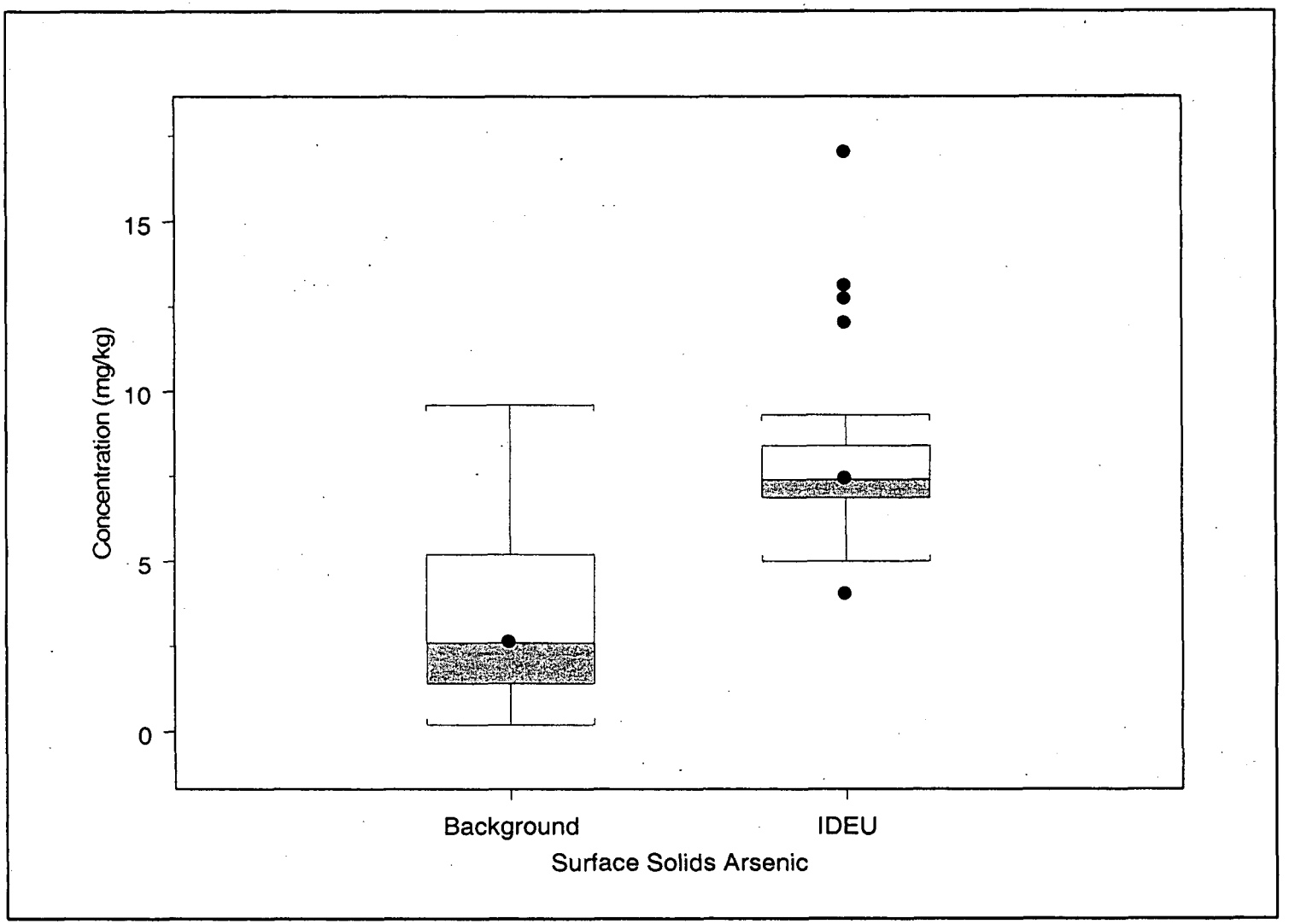
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.2
IDEU Surface Soil (Non-PMJM) Box Plots for Aluminum



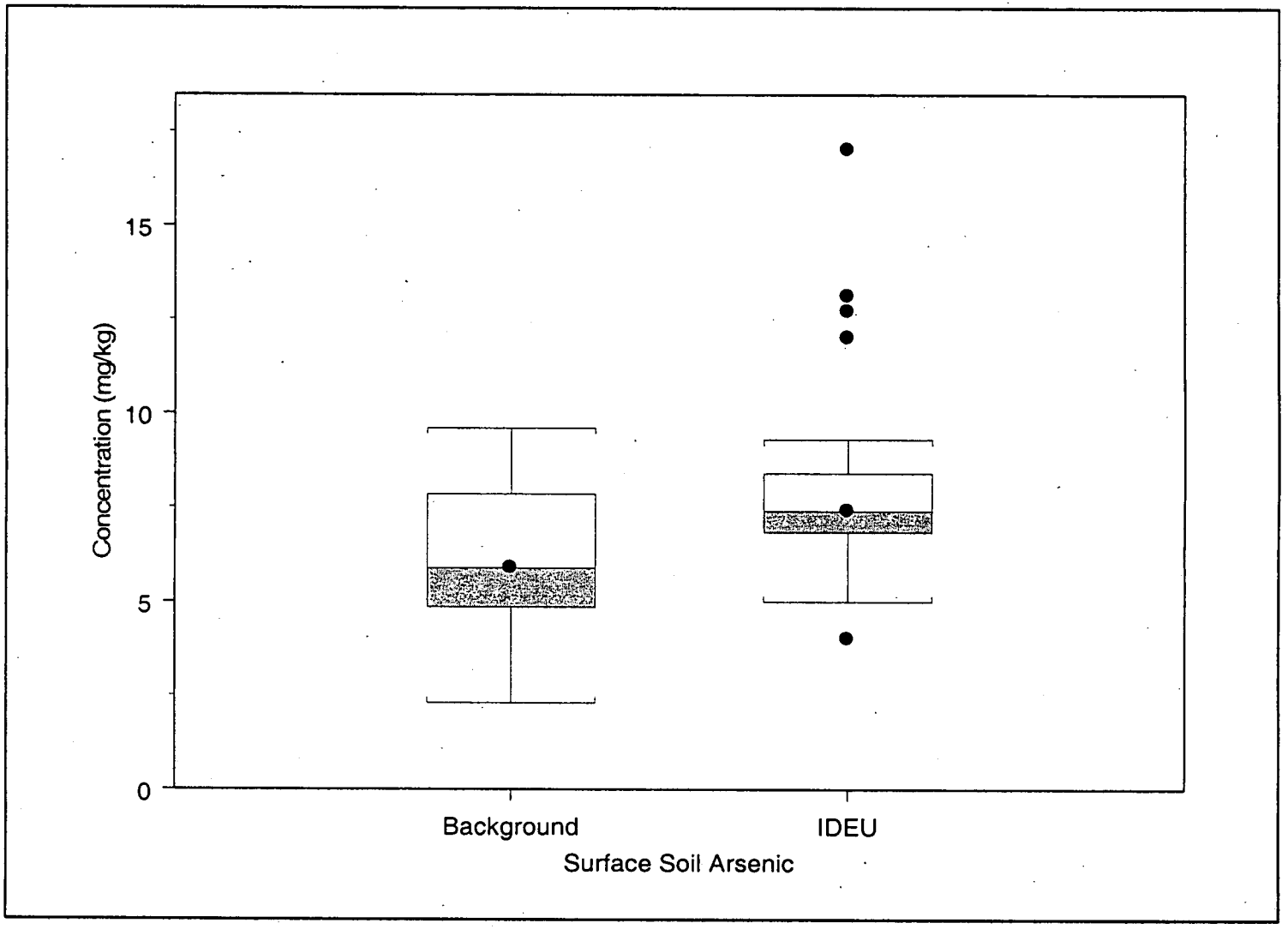
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.3
IDEU Surface Soil/Surface Sediment Box Plots for Arsenic



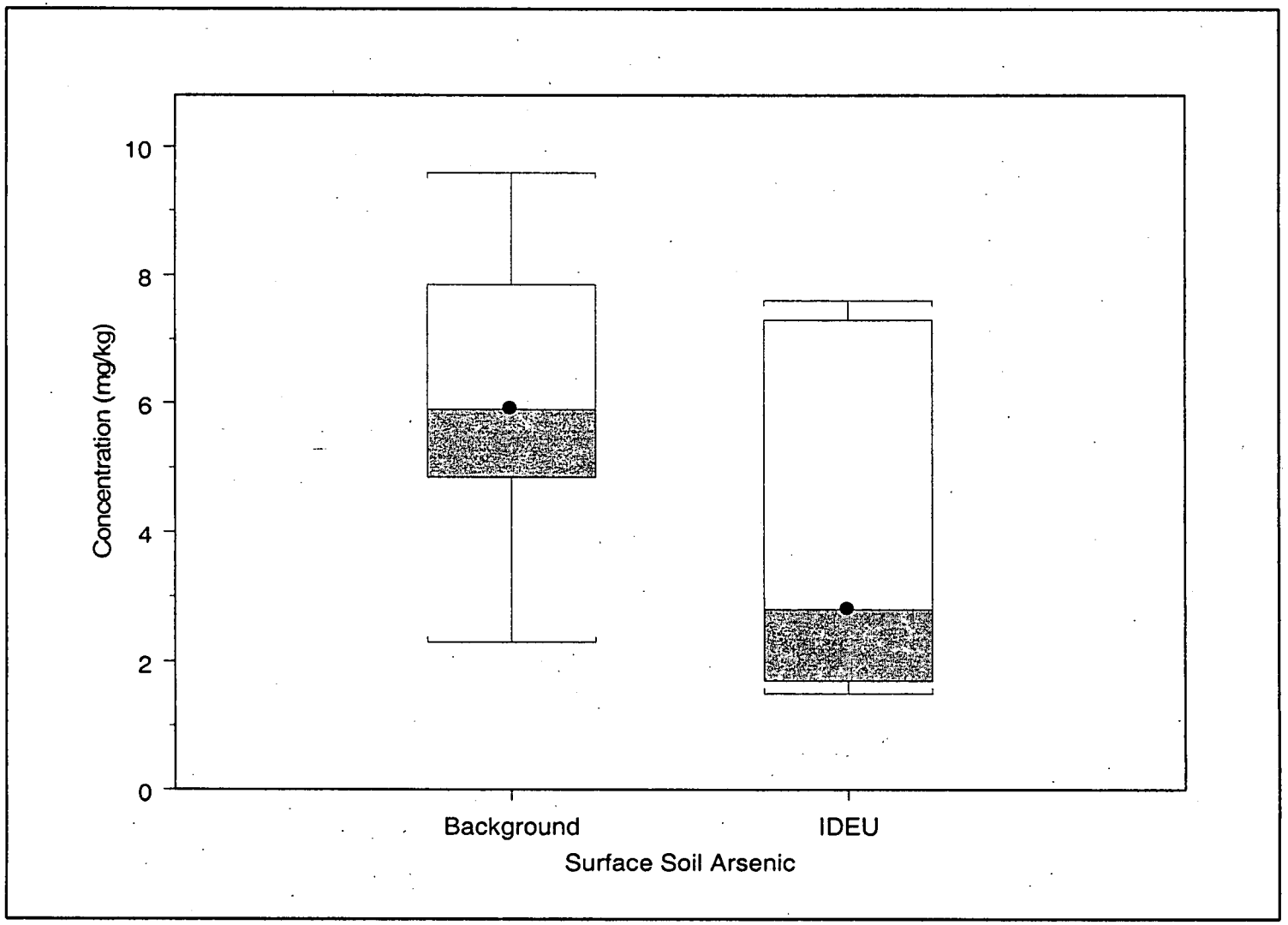
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.4
IDEU Surface Soil (Non-PMJM) Box Plots for Arsenic



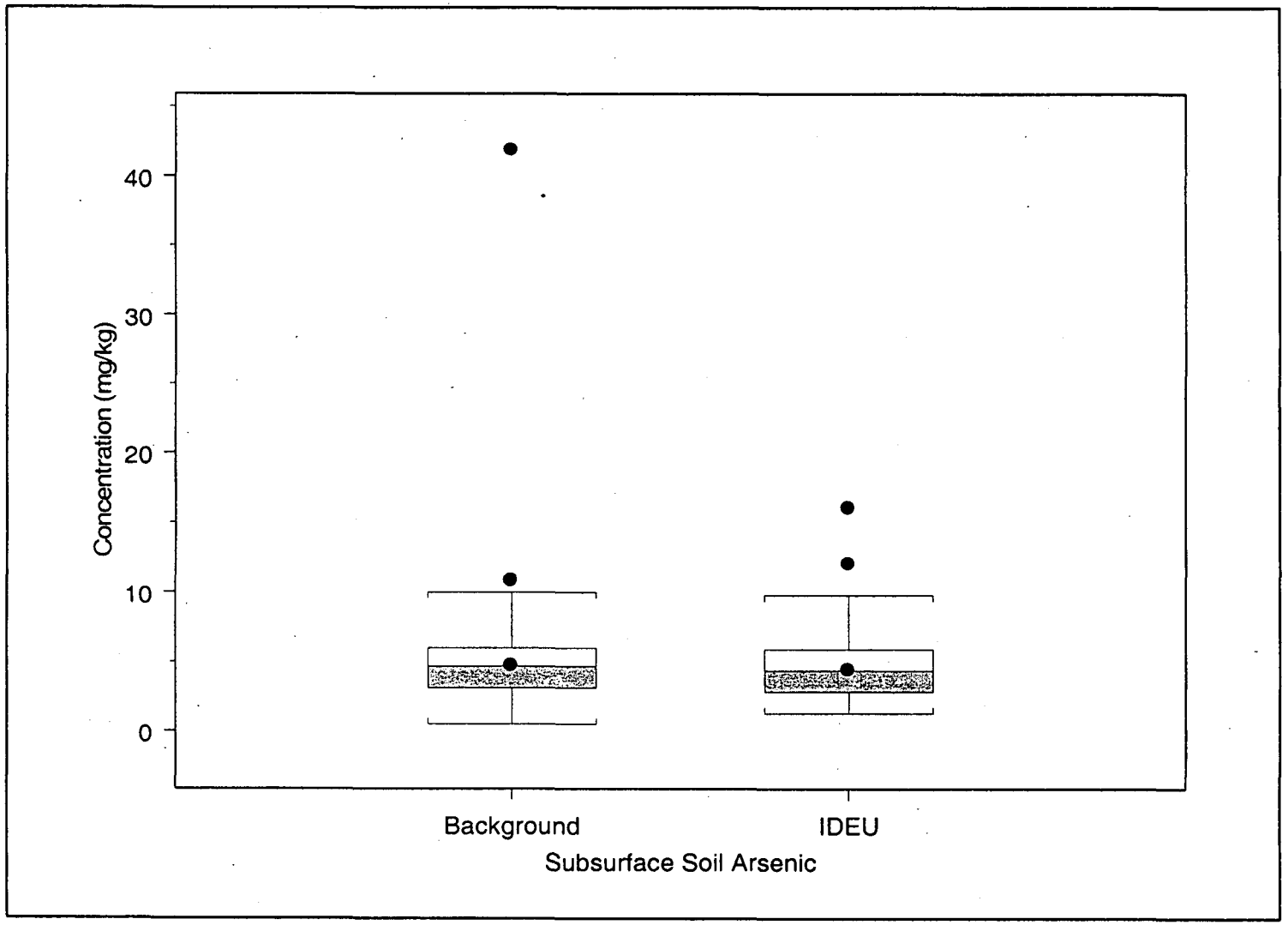
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.5
IDEU Surface Soil (PMJM) Box Plots for Arsenic



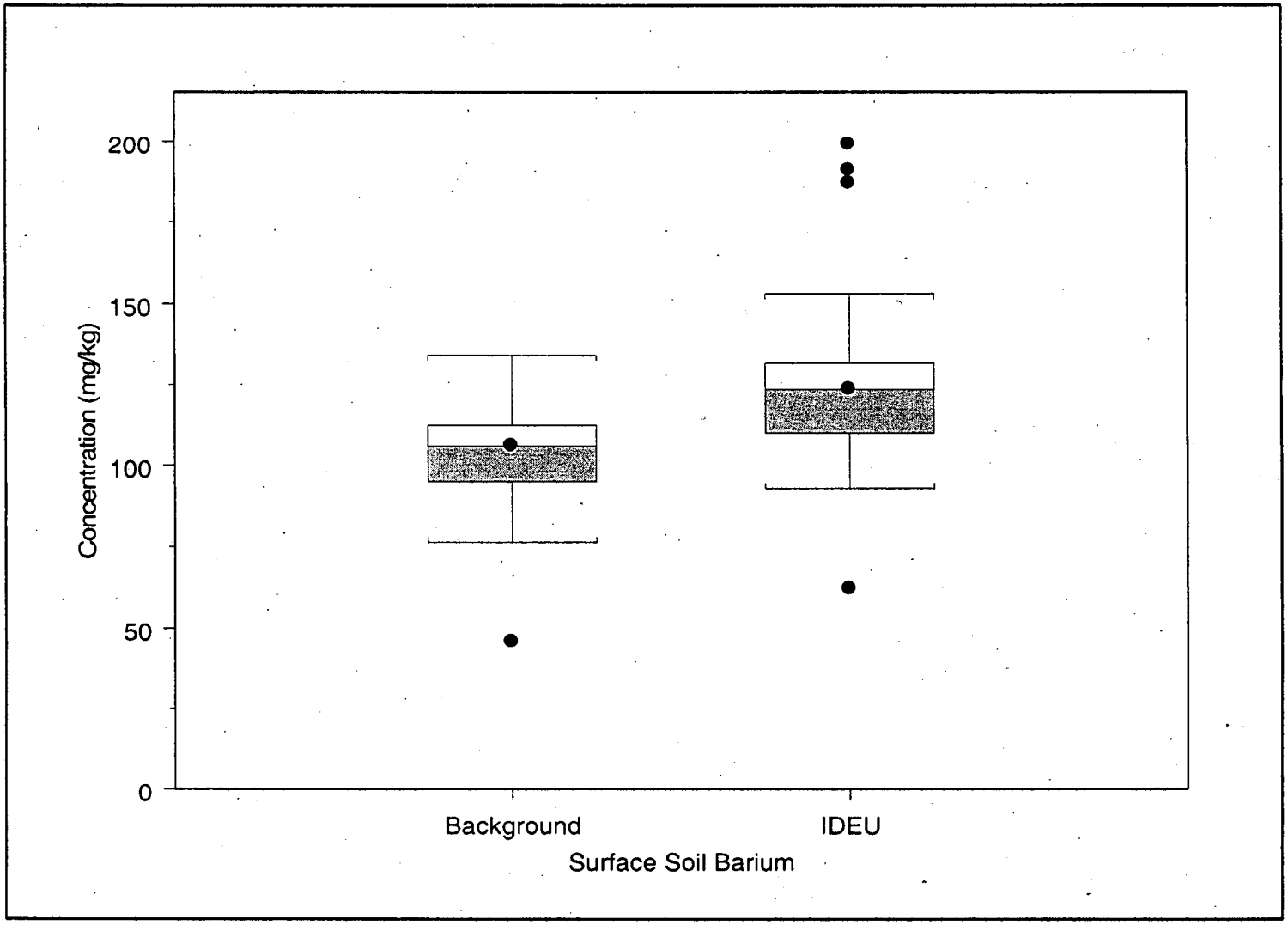
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.6
IDEU Subsurface Soil Box Plots for Arsenic



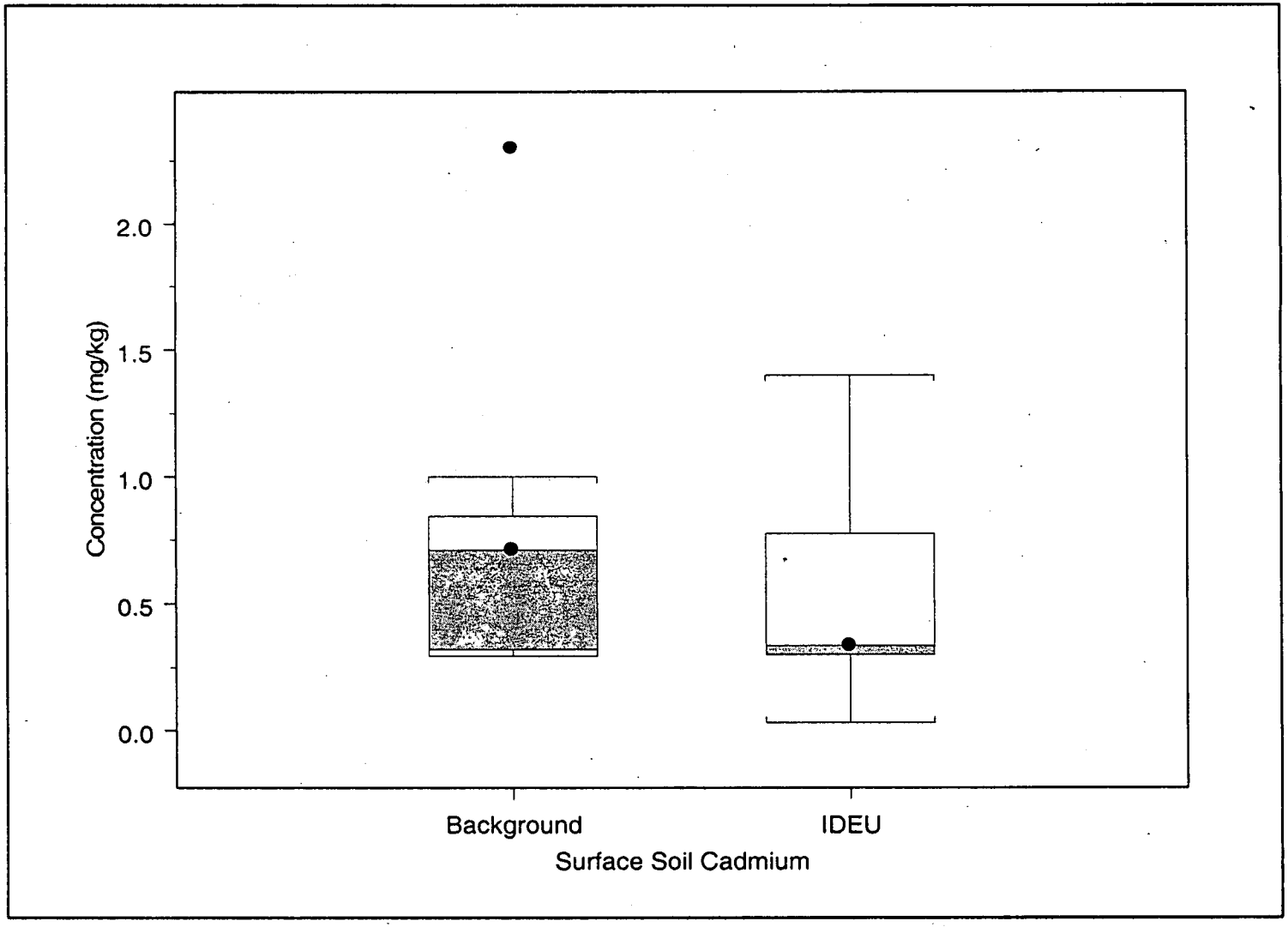
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.7
IDEU Surface Soil (Non-PMJM) Box Plots for Barium



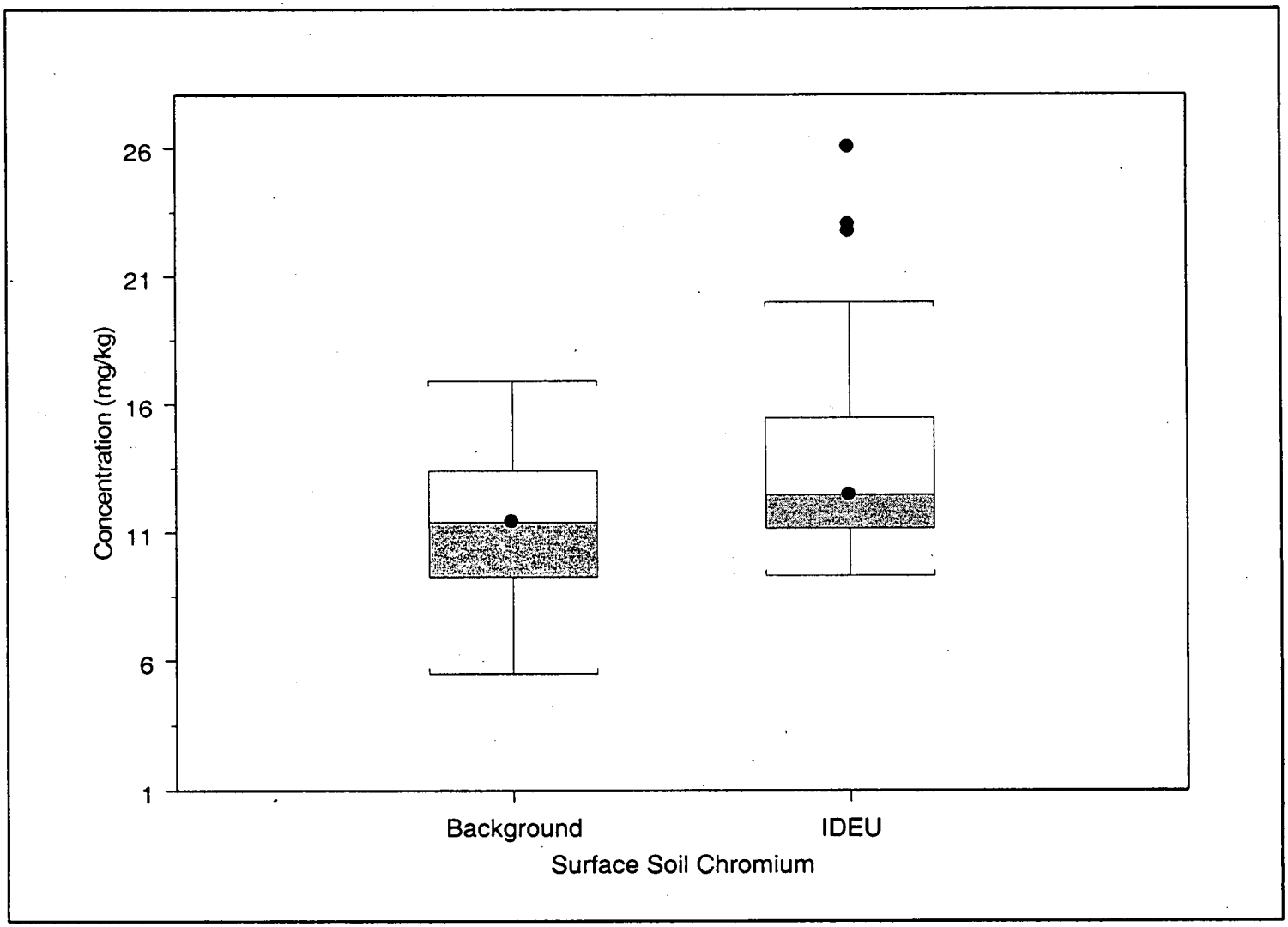
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.8
IDEU Surface Soil (Non-PMJM) Box Plots for Cadmium



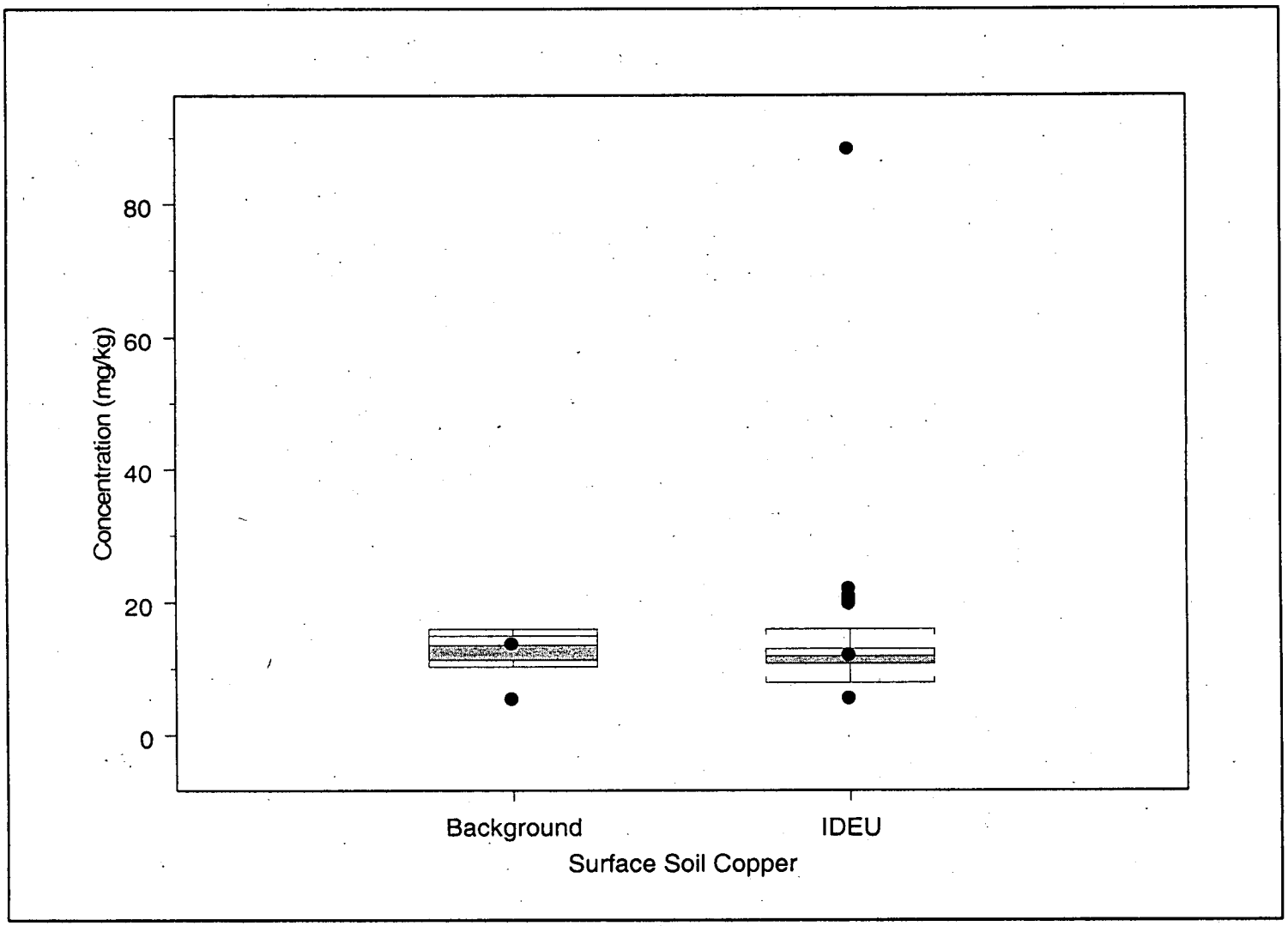
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.9
IDEU Surface Soil (Non-PMJM) Box Plots for Chromium



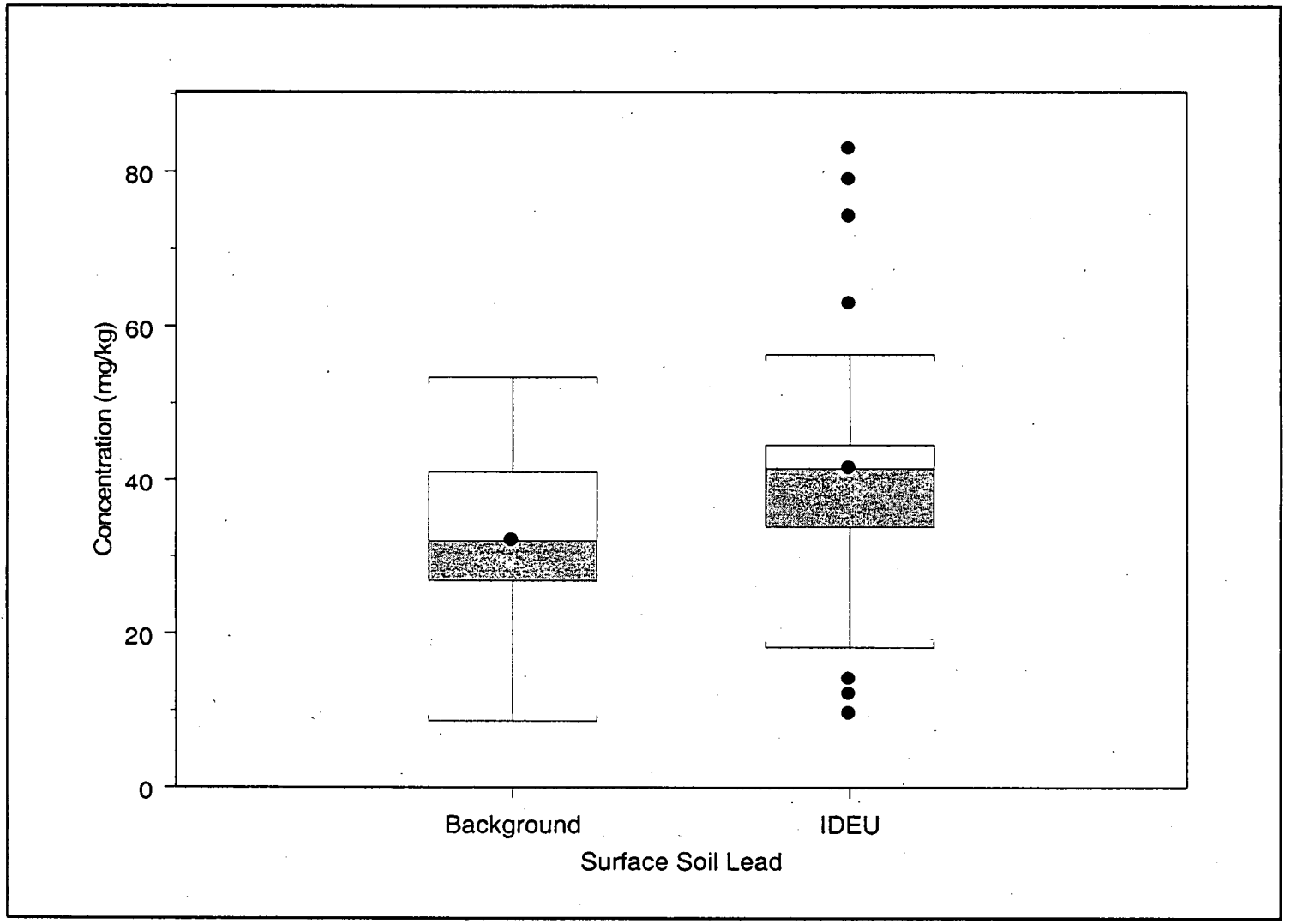
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 4.2.2.10
IDEU Surface Soil (Non-PMJM) Box Plots for Copper



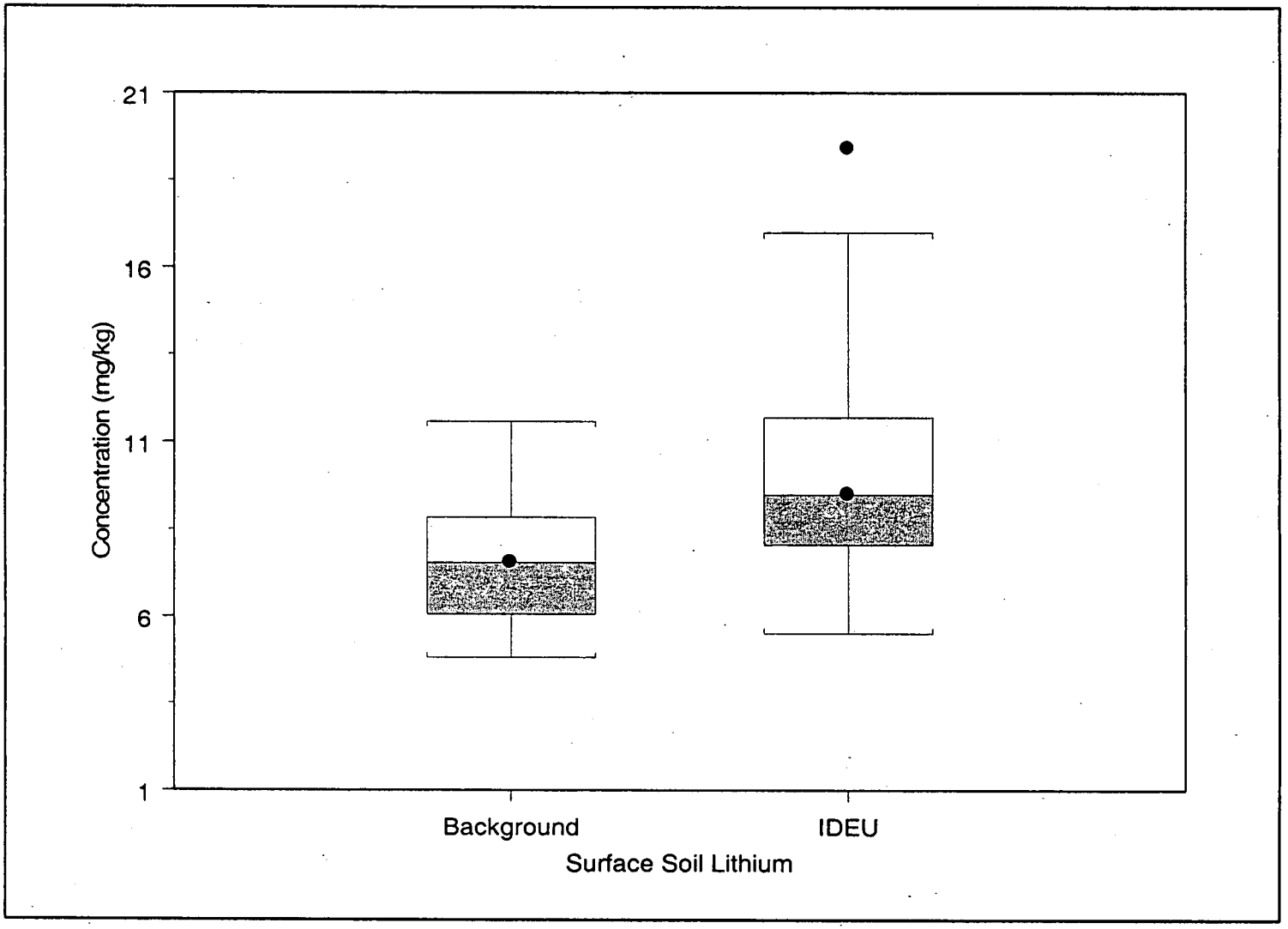
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 6.2.11
IDEU Surface Soil (Non-PMJM) Box Plots for Lead



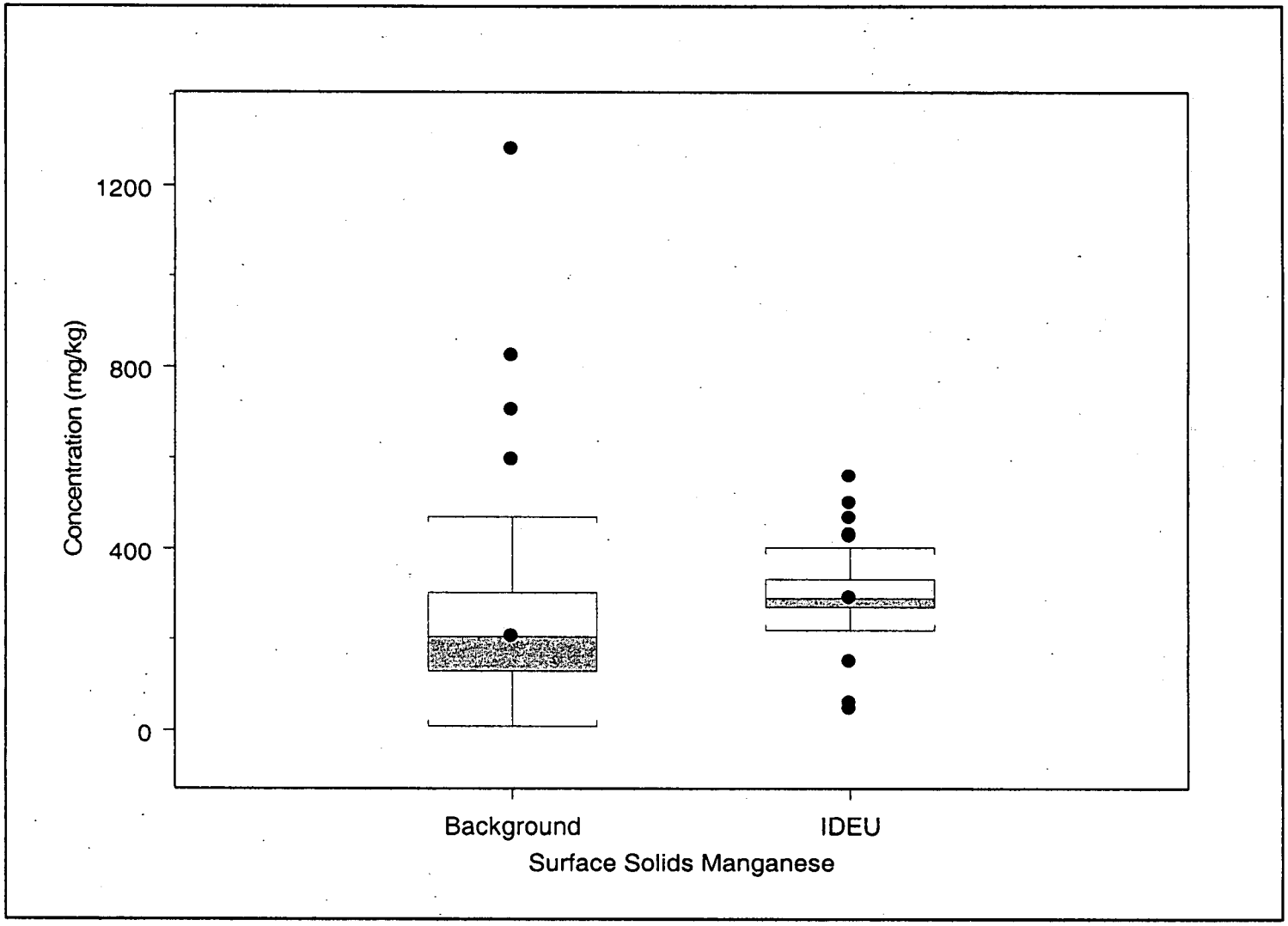
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 2.2.12
IDEU Surface Soil (Non-PMJM) Box Plots for Lithium



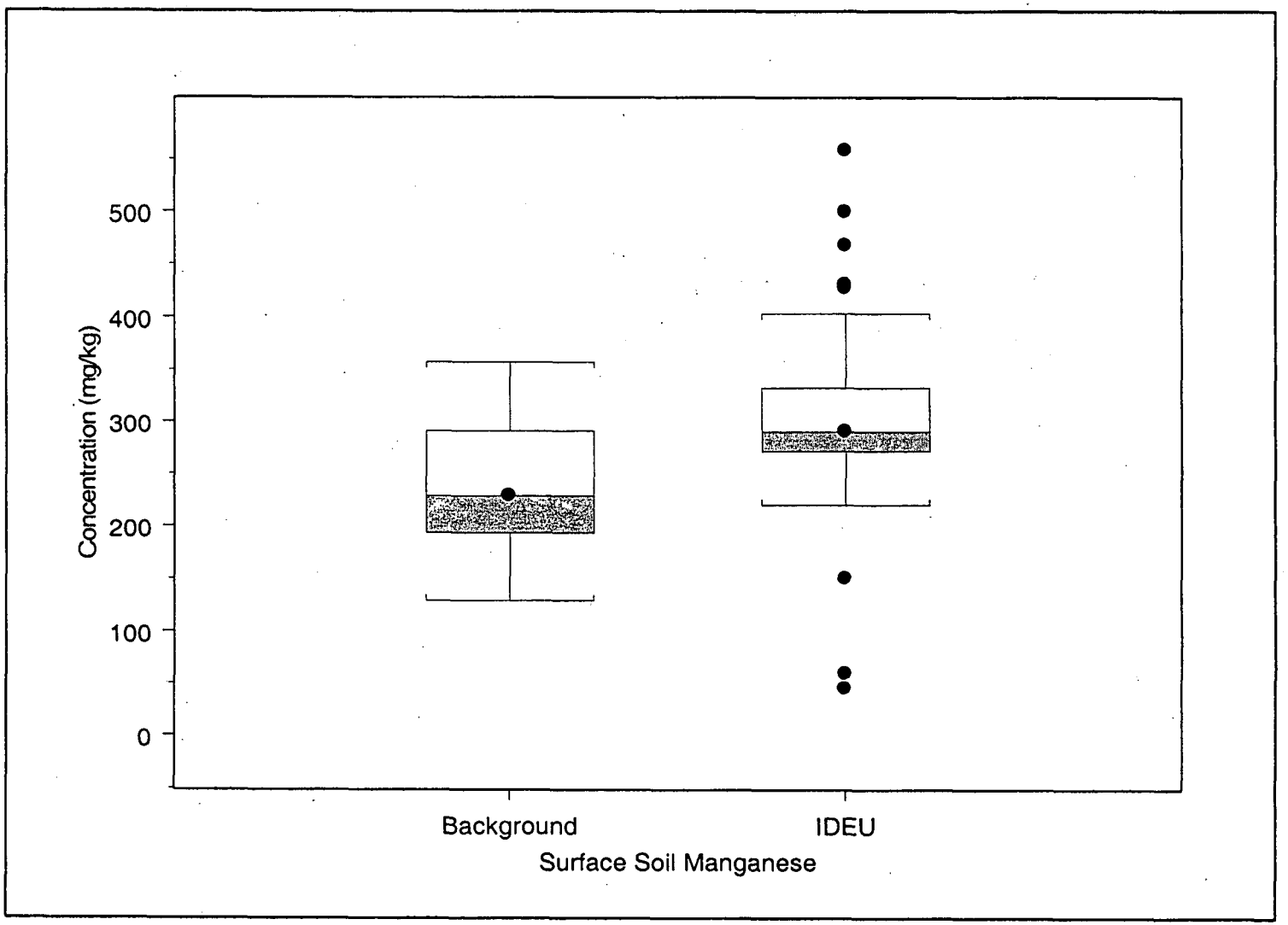
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.13
IDEU Surface Soil/Surface Sediment Box Plots for Manganese



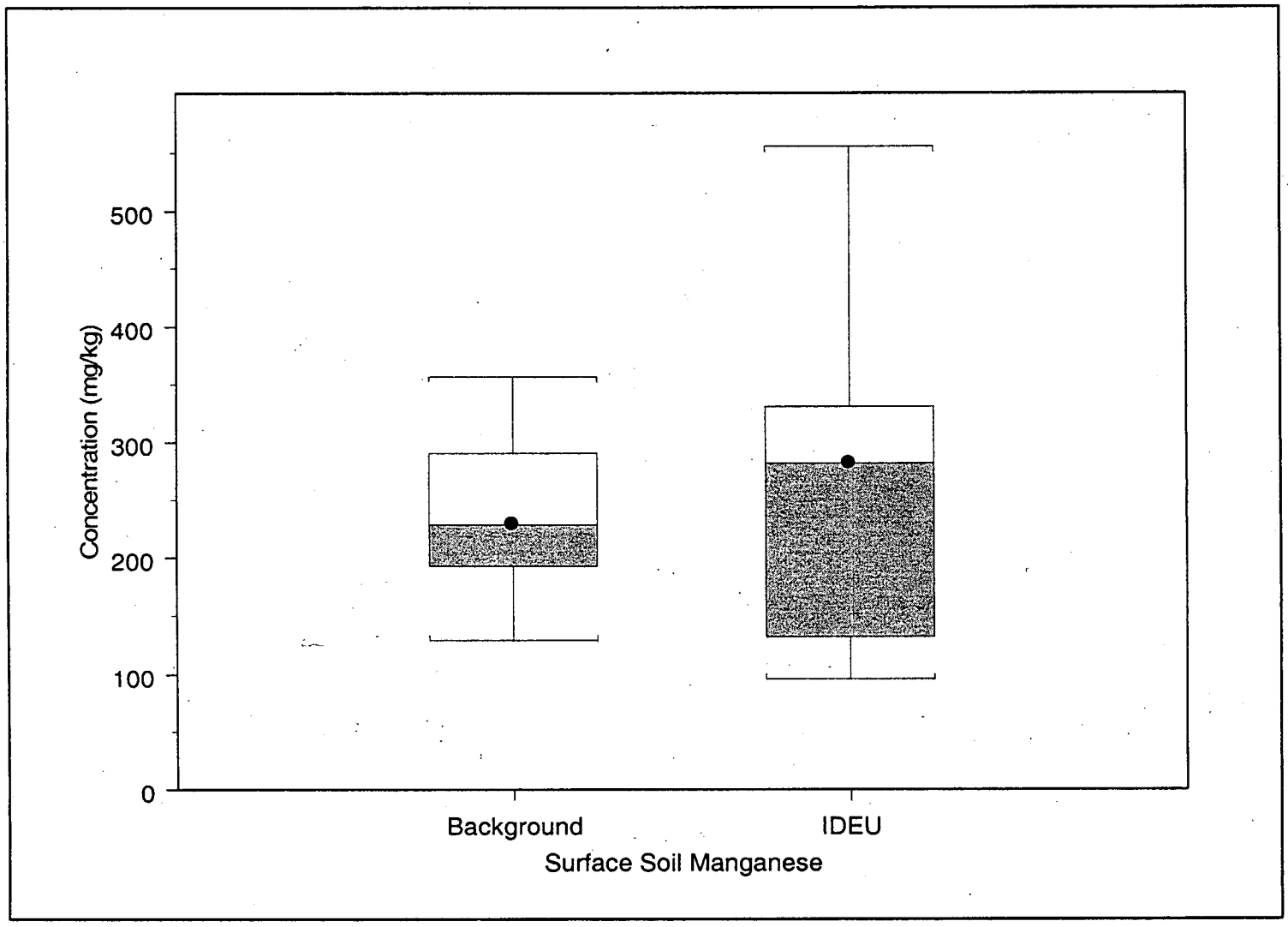
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 5.2.14
IDEU Surface Soil (Non-PMJM) Box Plots for Manganese



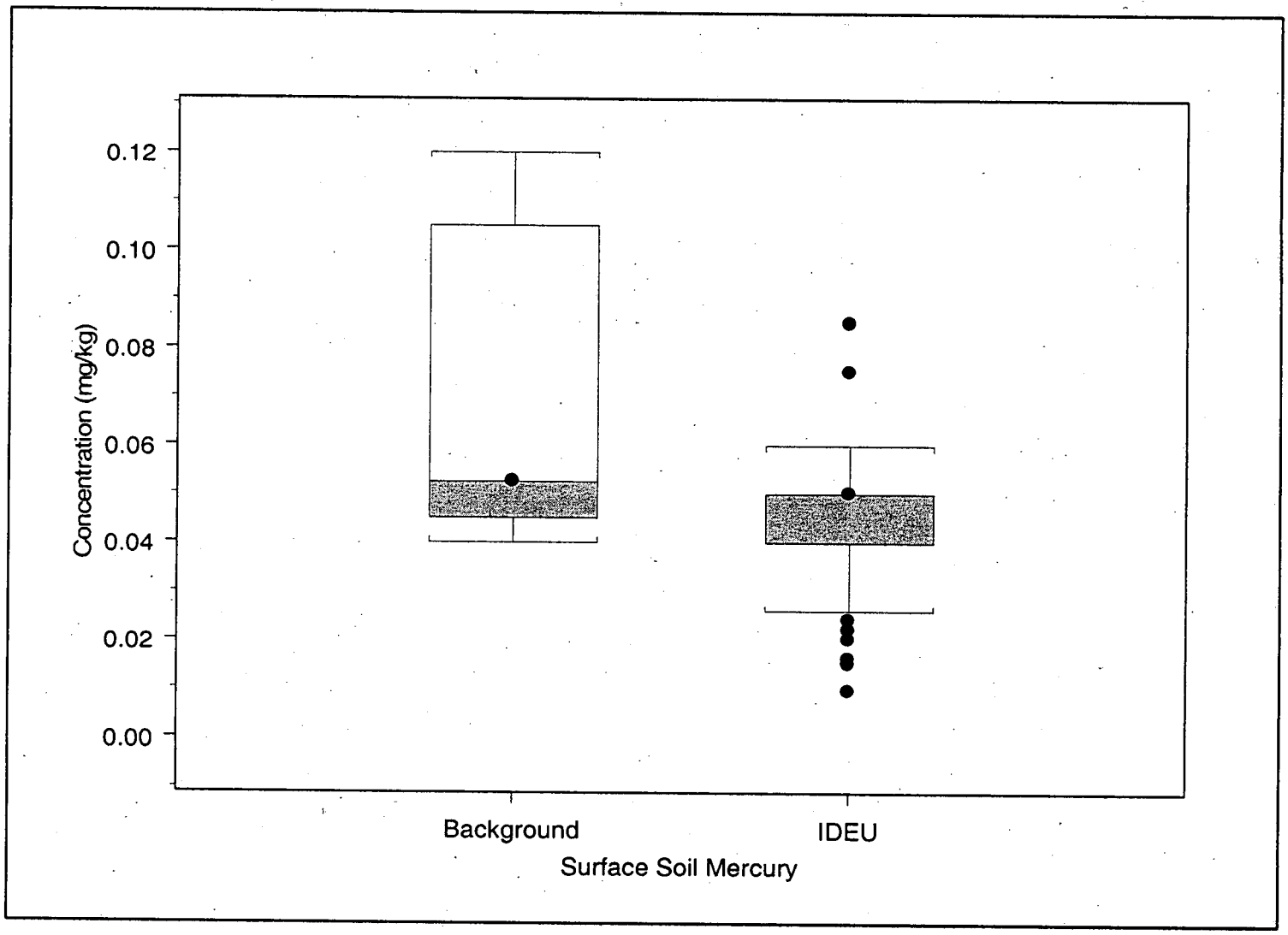
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.15
IDEU Surface Soil (PMJM) Box Plots for Manganese



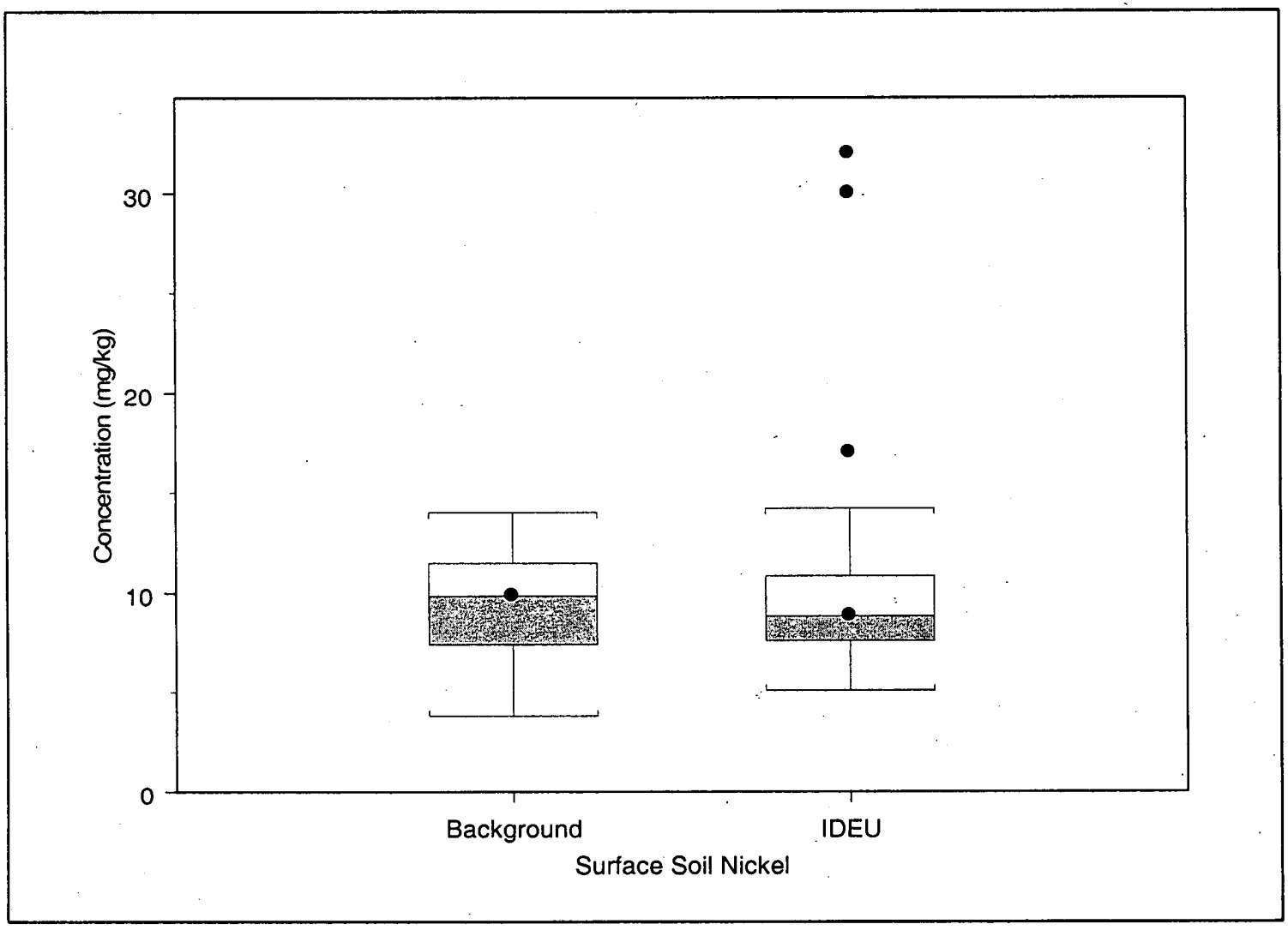
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.16
IDEU Surface Soil (Non-PMJM) Box Plots for Mercury



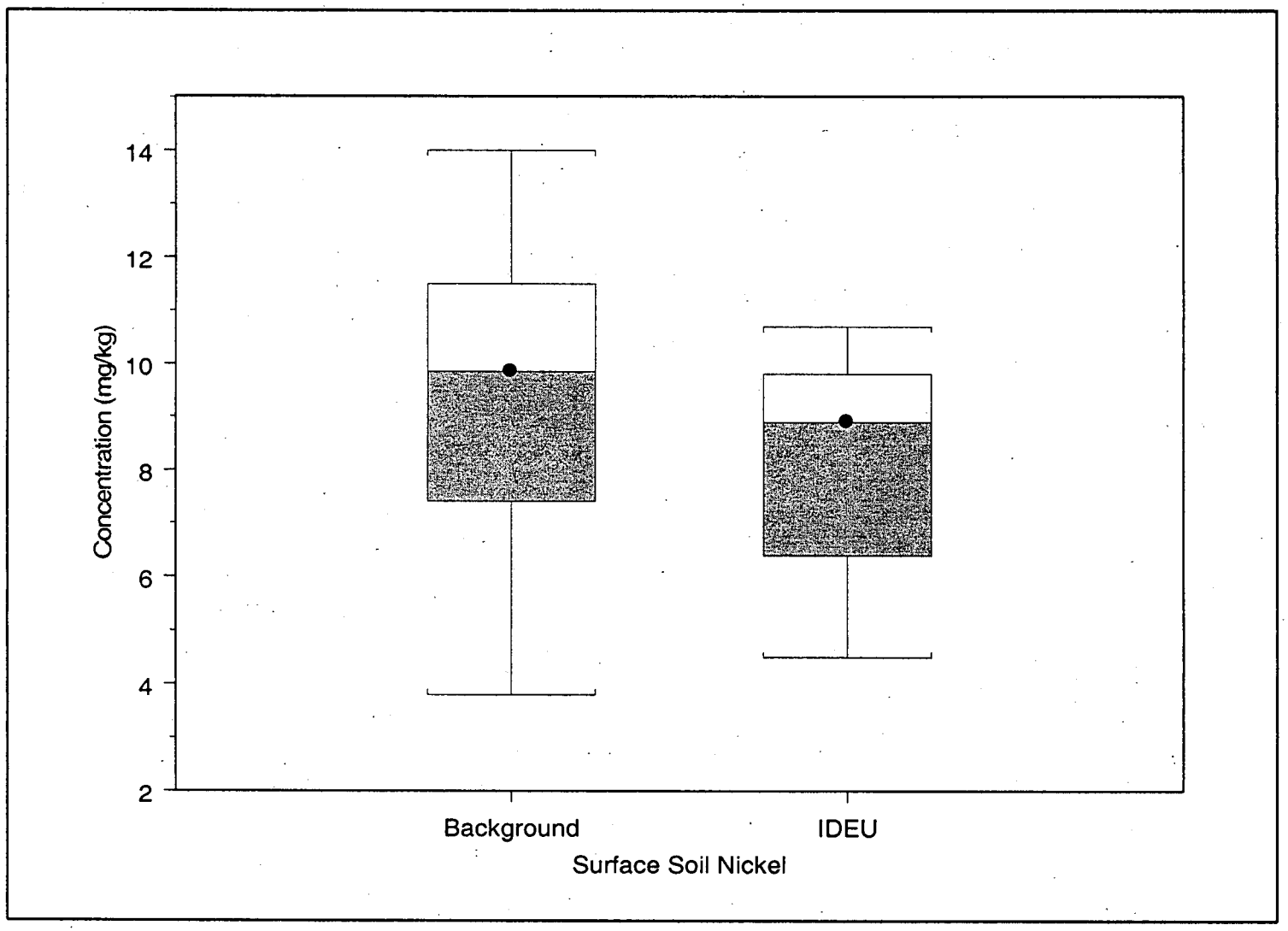
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 5.2.17
IDEU Surface Soil (Non-PMJM) Box Plots for Nickel



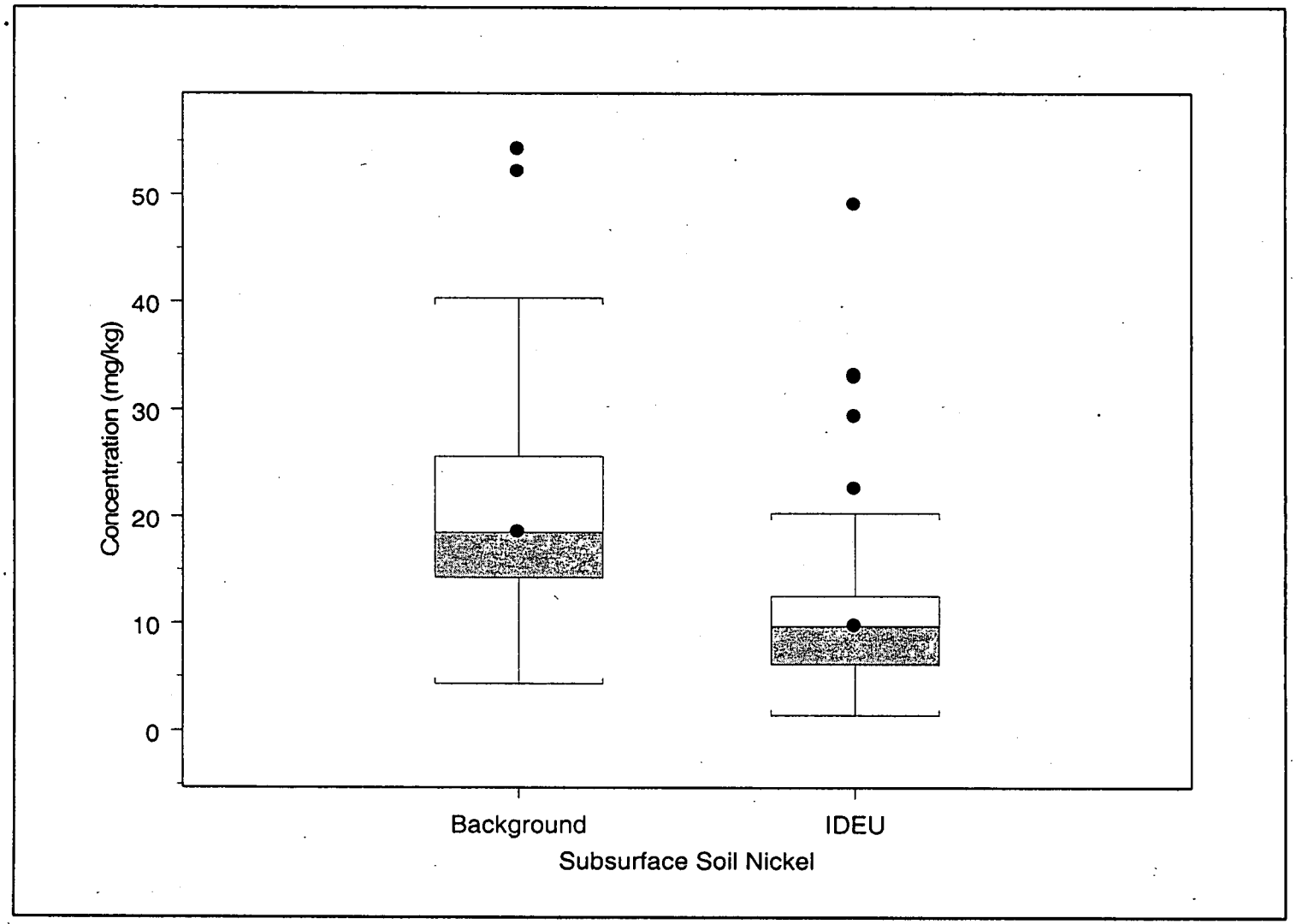
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.18
IDEU Surface Soil (PMJM) Box Plots for Nickel



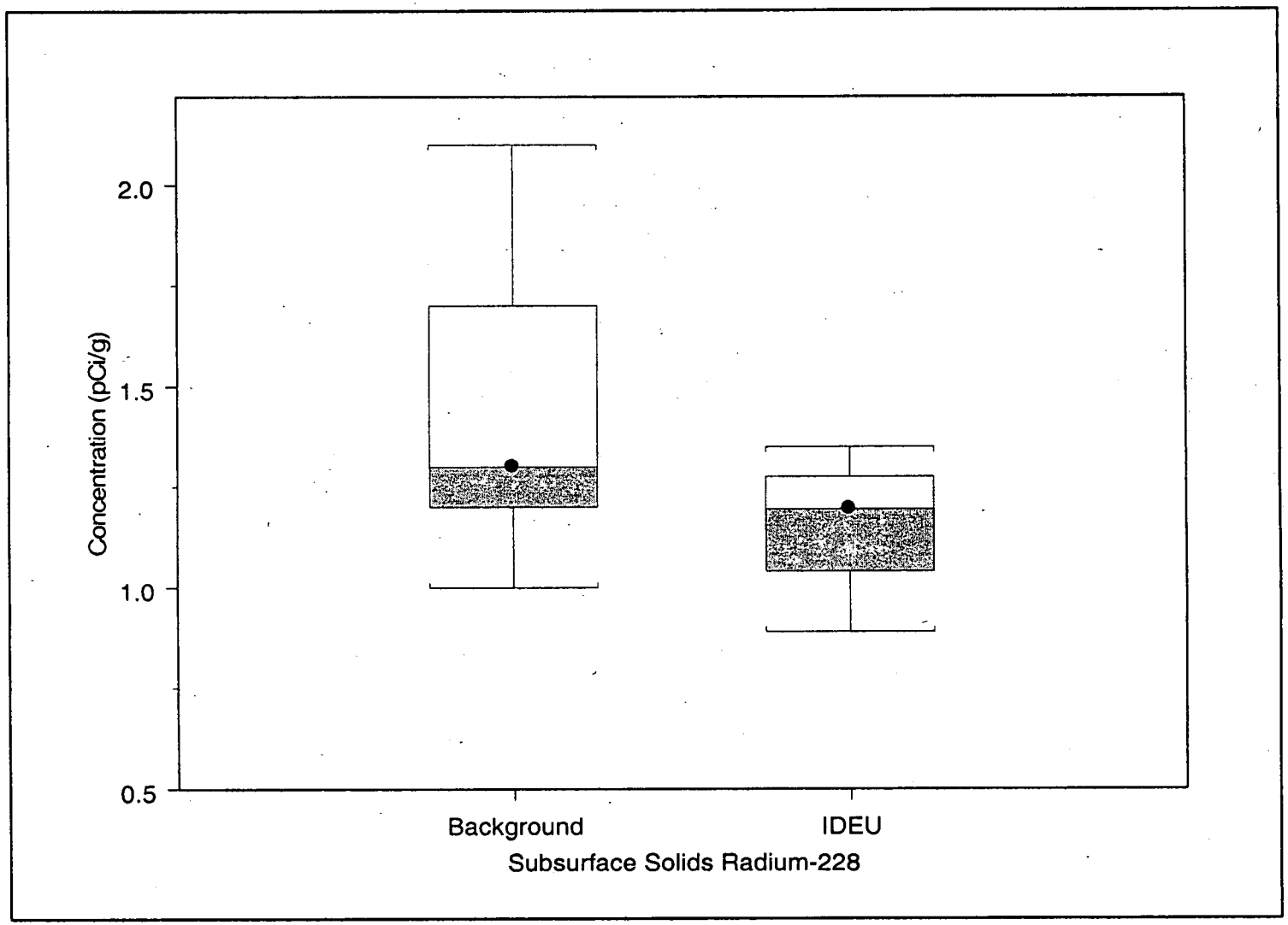
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 2.2.19
IDEU Subsurface Soil Box Plots for Nickel



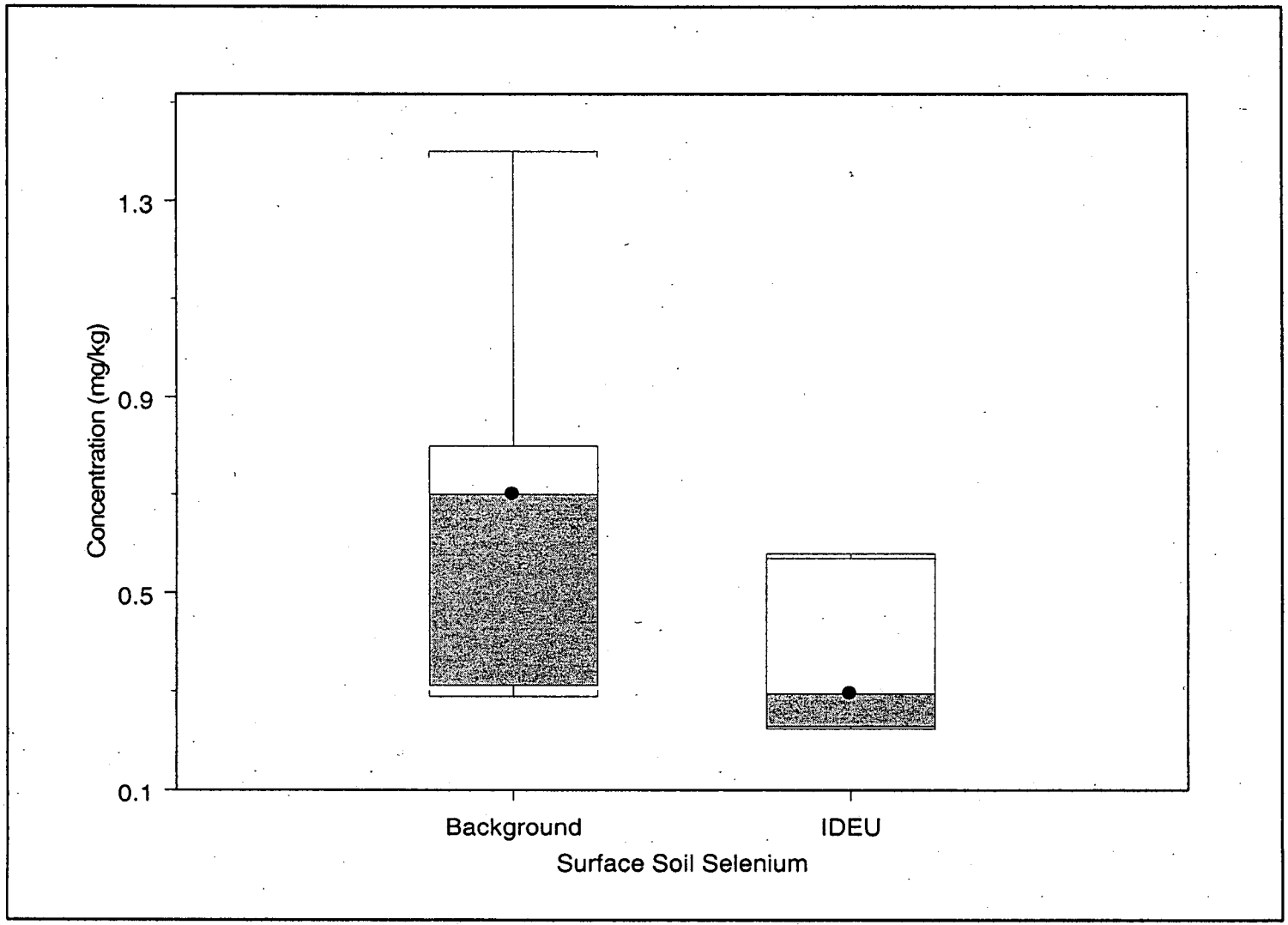
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 5.2.20
IDEU Subsurface Soil/Subsurface Sediment Box Plots for Radium-228



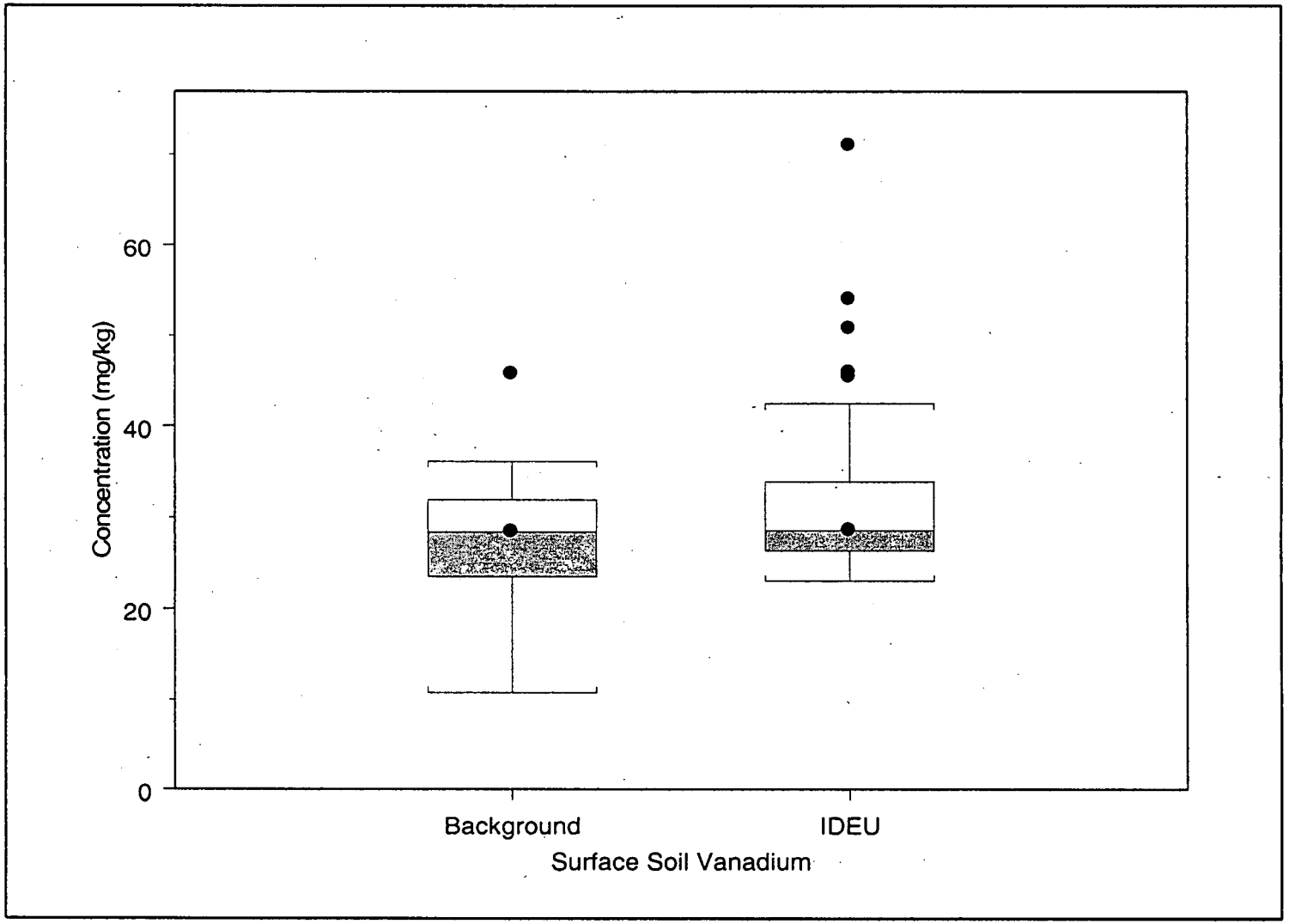
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 2.2.21
IDEU Surface Soil (PMJM) Box Plots for Selenium



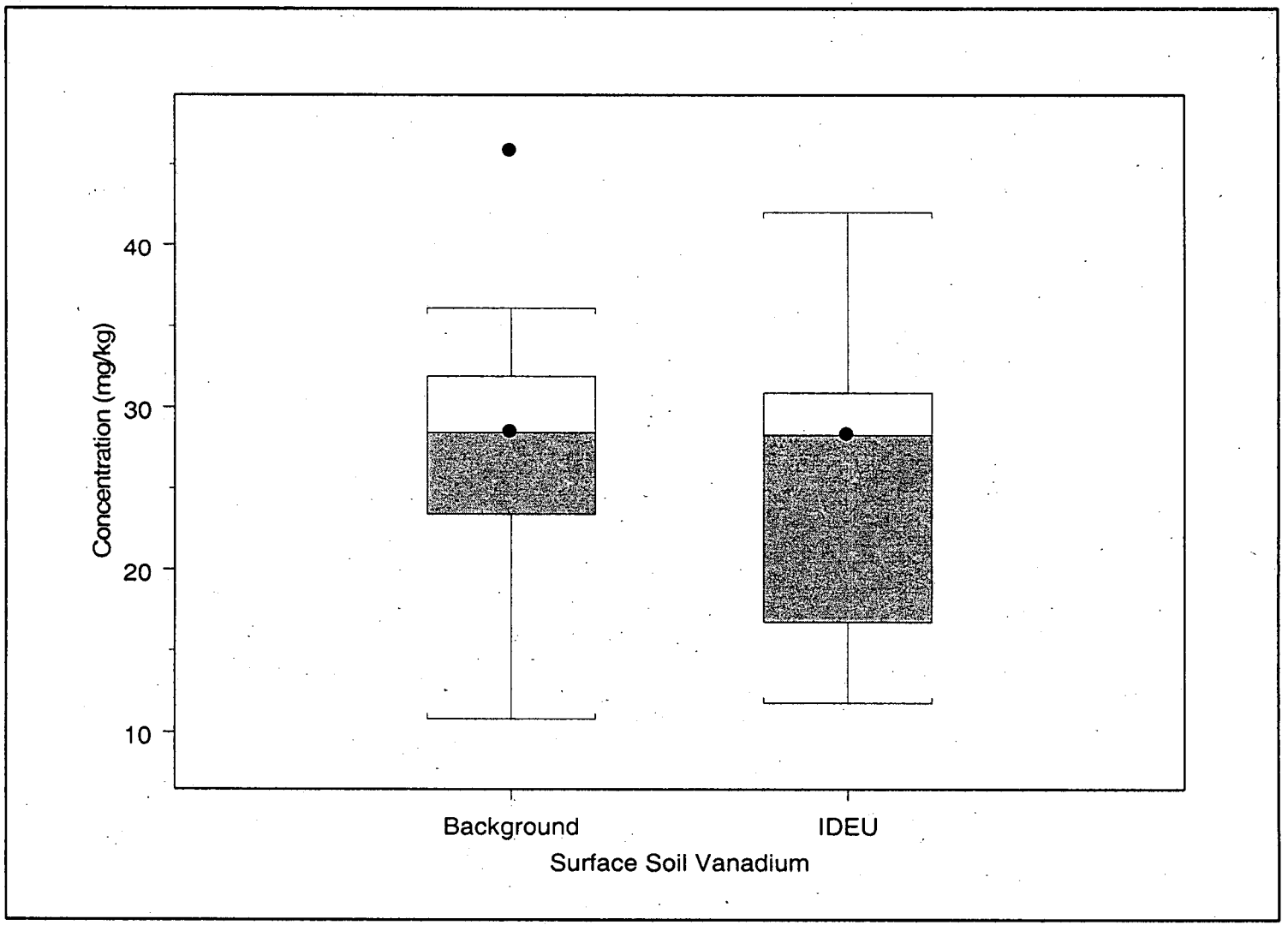
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 4.3.2.22
IDEU Surface Soil (Non-PMJM) Box Plots for Vanadium



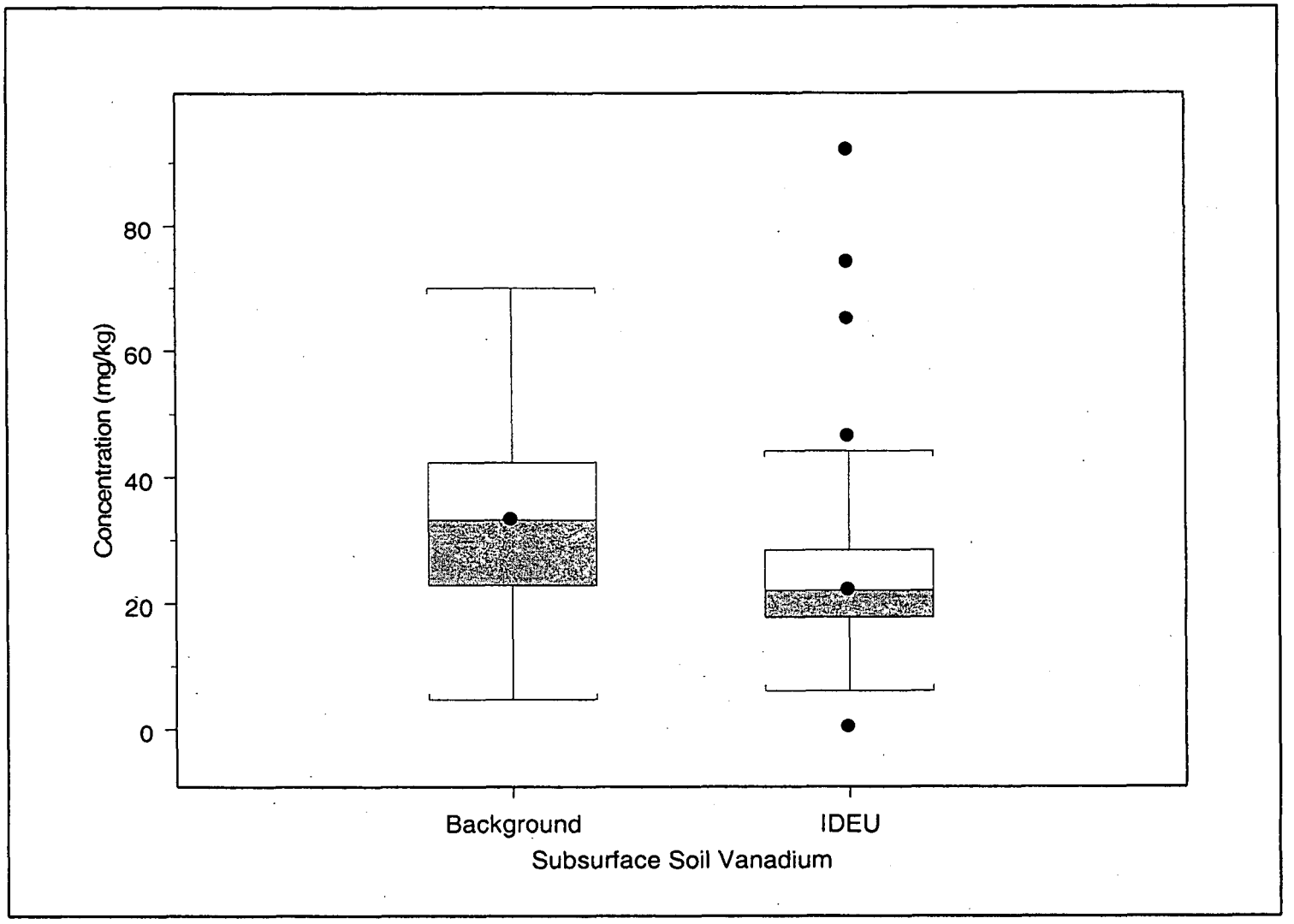
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 6.2.23
IDEU Surface Soil (PMJM) Box Plots for Vanadium



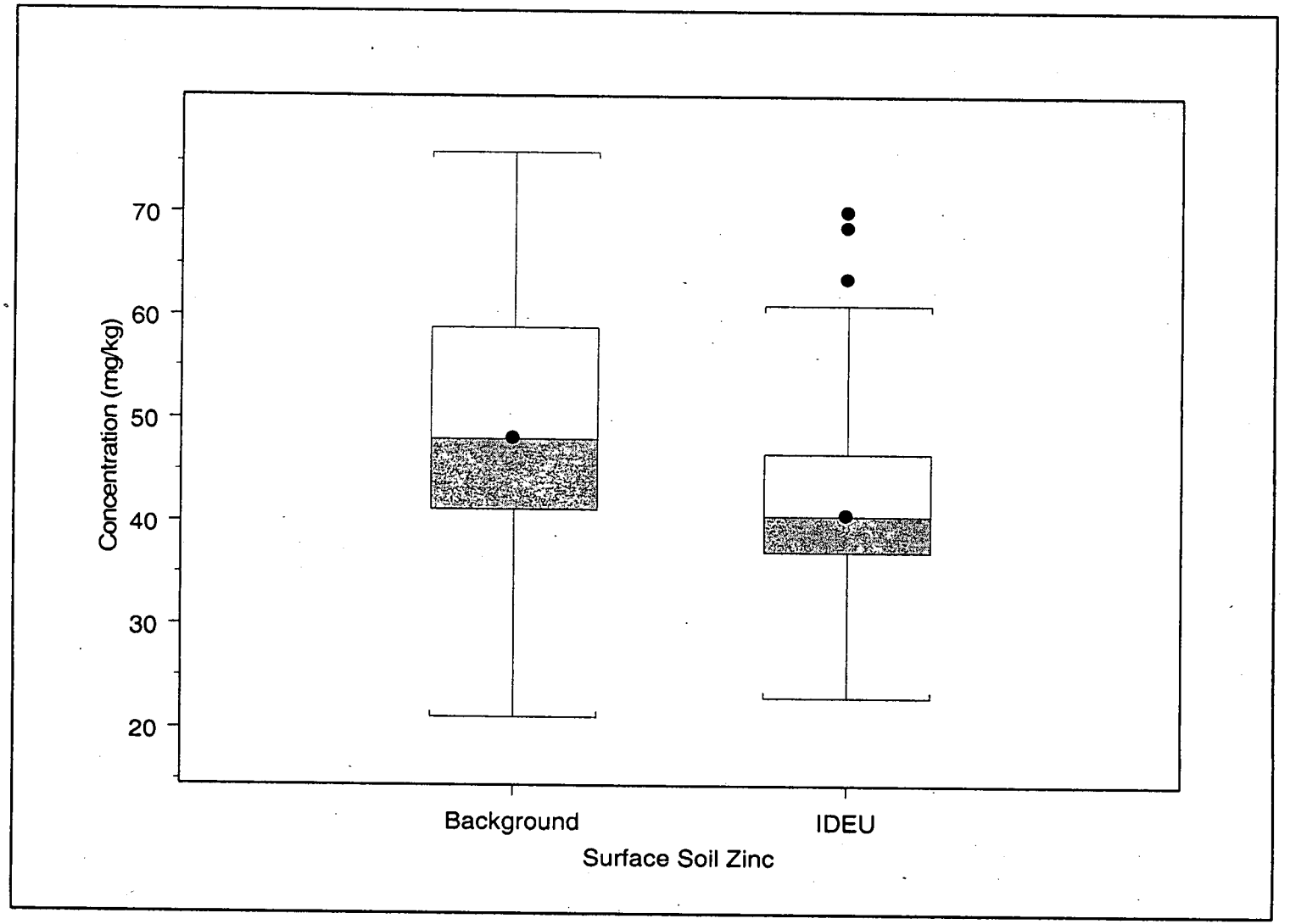
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.24
IDEU Subsurface Soil Box Plots for Vanadium



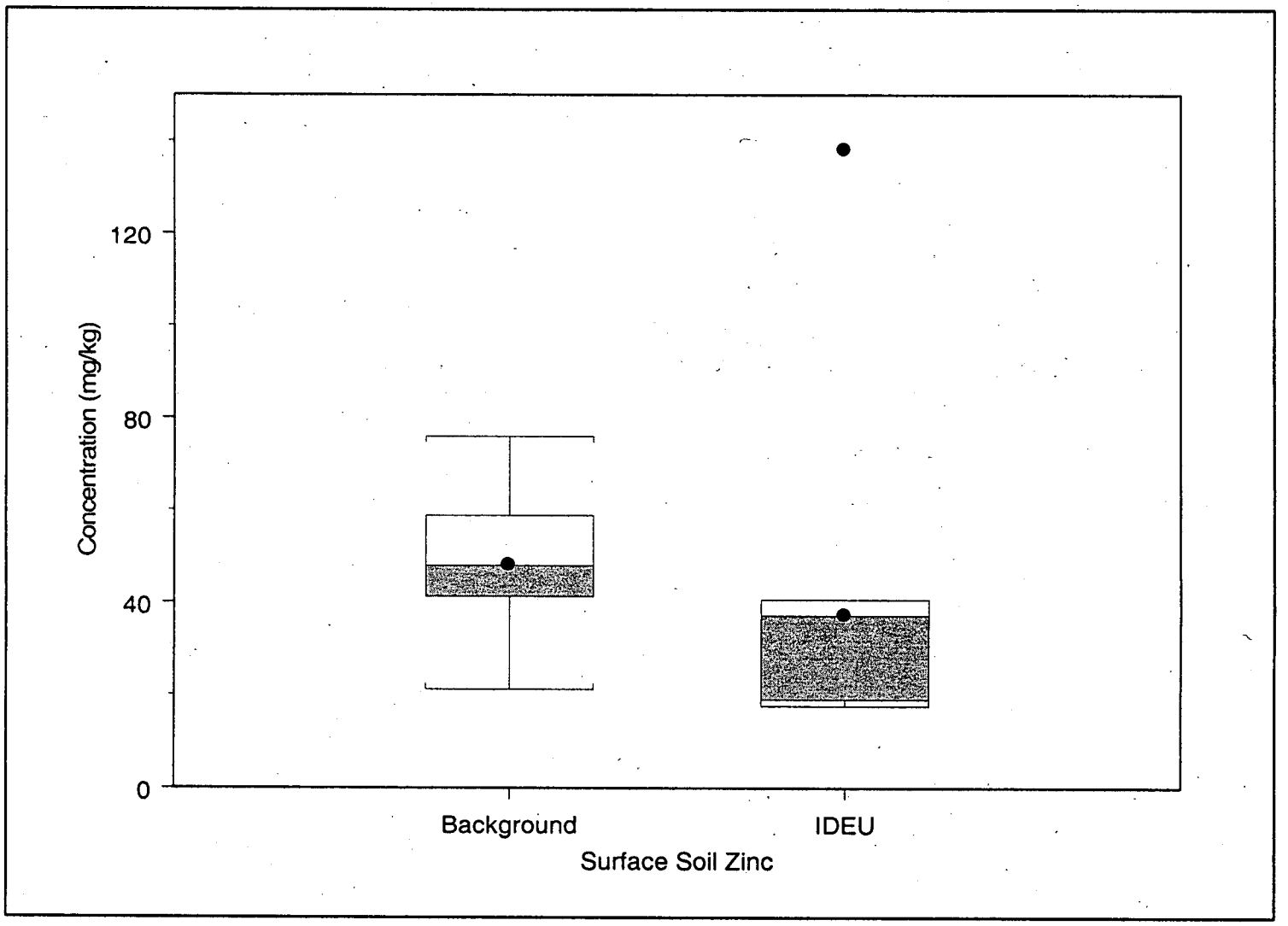
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 2.2.25
IDEU Surface Soil (Non-PMJM) Box Plots for Zinc



Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure 3.2.26
IDEU Surface Soil (PMJM) Box Plots for Zinc



Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

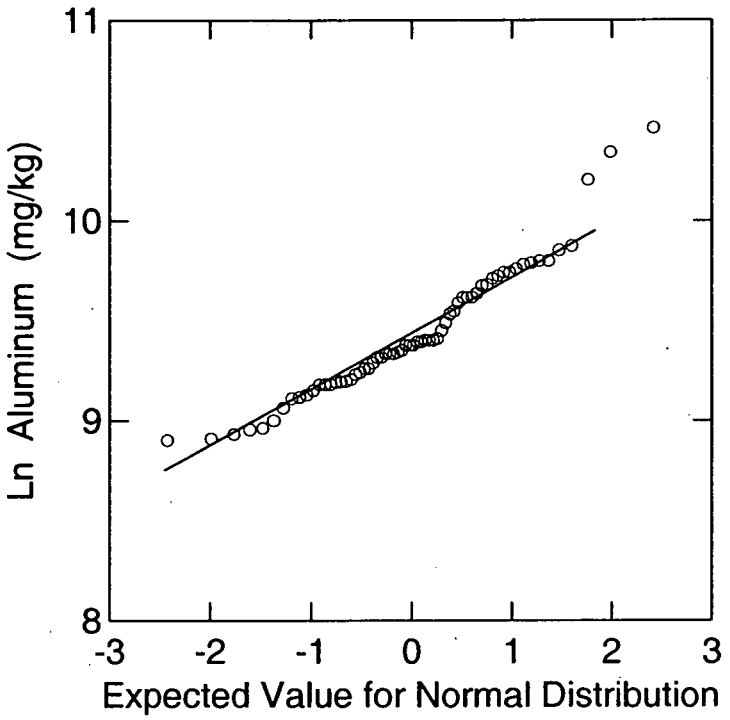


Figure A3.4.1 **Probability Plot for Aluminum Concentrations (Natural Logarithm) in IDEU Surface Soil**

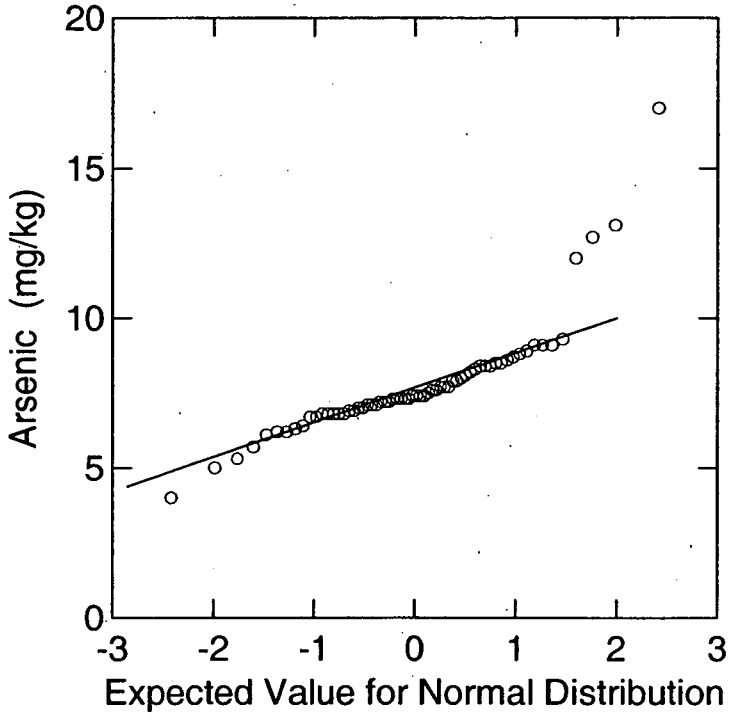


Figure A3.4.2 **Probability Plot for Arsenic Concentrations in IDEU Surface Soil/Surface Sediment**

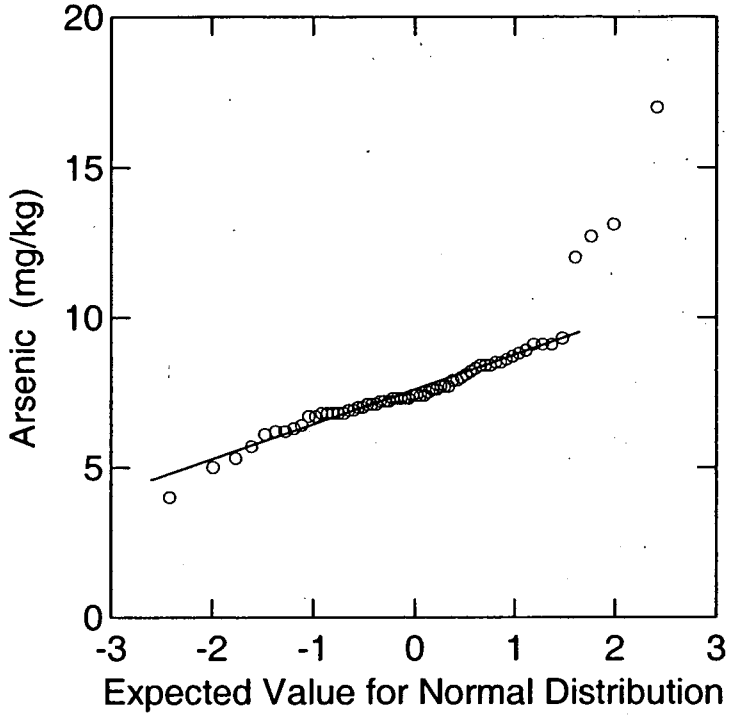


Figure A3.4.3 Probability Plot for Arsenic Concentrations in IDEU Surface Soil

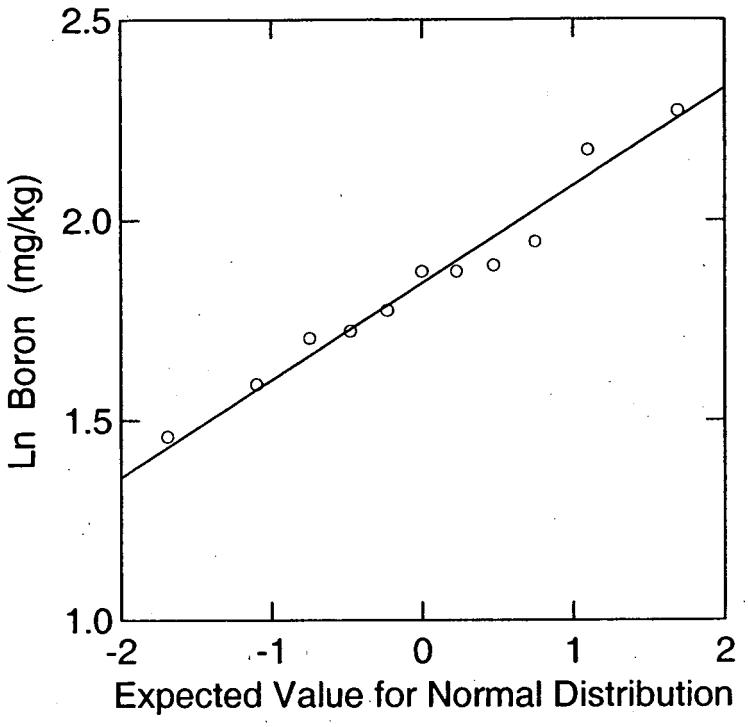


Figure A3.4.4 **Probability Plot for Boron Concentrations (Natural Logarithm) in IDEU Surface Soil**

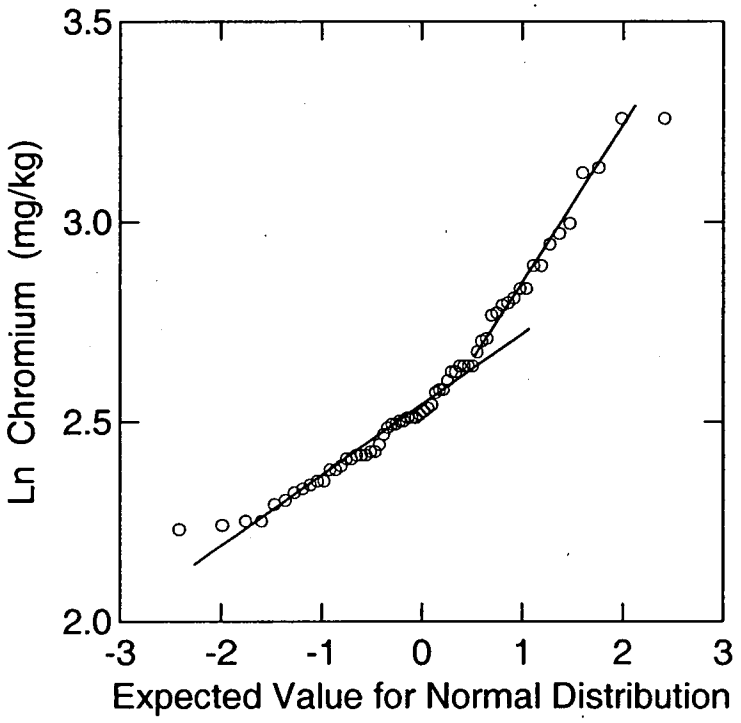


Figure A3.4.5 **Probability Plot for Chromium Concentrations (Natural Logarithm) in IDEU Surface Soil**

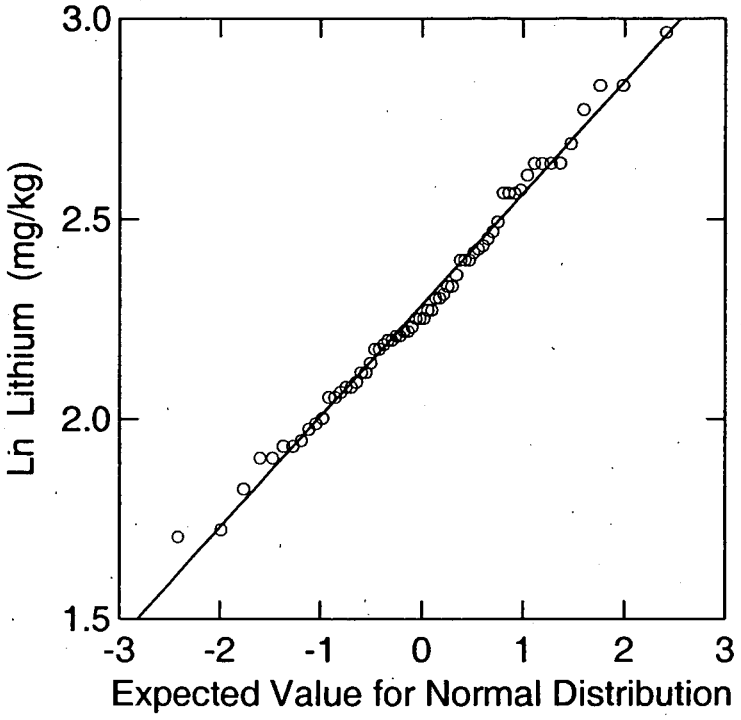


Figure A3.4.6 **Probability Plot for Lithium Concentrations (Natural Logarithm) in IDEU Surface Soil**

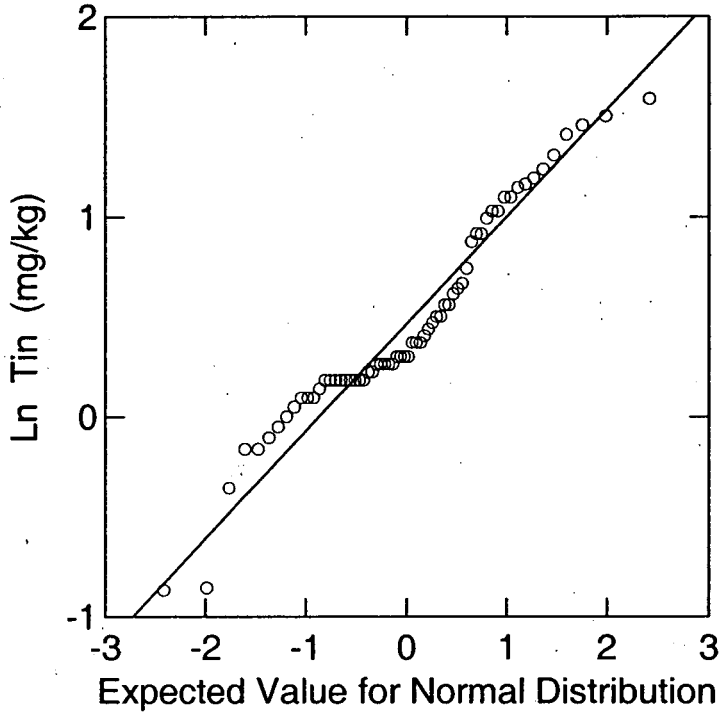


Figure A3.4.7 **Probability Plot for Tin Concentrations (Natural Logarithm) in IDEU Surface Soil**

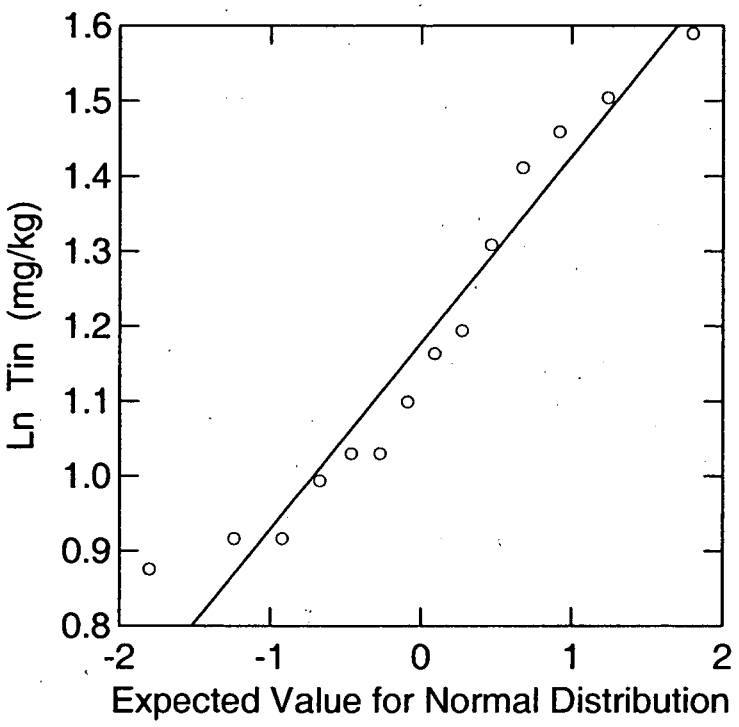


Figure A3.4.8 **Probability Plot for Tin Concentrations (Natural Logarithm) in IDEU Surface Soil. Samples with nondetected tin concentrations have been removed.**

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Risk Assessment Calculations

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1.0 ECOLOGICAL RISK ASSESSMENT TABLES

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Table A4.1.1

Non-PMJM Intake Estimates for Antimony - Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -3.233 + 0.938(lnCs)	1	BAFsm = ((0.5*BAFsp)+(0.5*BAFsi))*0.003*50)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
3.1	Tier 1 95th UTL	0.11	3.1	0.24	0.028	
1.9	Tier 1 95th UCL	0.07	1.9	0.15	0.017	
1.65	Tier 2 95th UTL	0.06	1.7	0.13	0.028	
1.23	Tier 2 95th UCL	0.05	1.2	0.10	0.017	
Intake Parameters						
	IR(food) (kg/kg BW day)	**IR(water) (kg/kg BW day)**	**IR(soil) (kg/kg BW day)**	**Pplant**	**Pinvert**	**Pmammal**
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Deer Mouse - Insectivore	N/A		N/A			
Tier 1 95th UTL	N/A	0.2015	N/A	0.00403	0.00532	2.11E-01
Tier 1 95th UCL	N/A	0.1235	N/A	0.00247	0.00323	1.29E-01
Tier 2 95th UTL	N/A	0.10725	N/A	0.002145	0.00532	1.15E-01
Tier 2 95th UCL	N/A	8.00E-02	N/A	1.60E-03	3.23E-03	8.48E-02

N/A = Not applicable.

Table A4.1.2

Non-PMJM Hazard Quotients for Antimony - Default Exposure Scenario

		TRV (mg/kg BW day)					Hazard Quotients				
	Total Intake (mg/kg BW day)	NOAEL	Threshold	LOAEL	Geometric Mean NOAEL	Geometric Mean LOAEL	NOAEL	Threshold	LOAEL	Geometric Mean NOAEL	Geometric Mean LOAEL
Deer Mouse - Insectivore											
Tier 1 95th UTL	2.11E-01	6.00E-02	1.88E-01	5.90E-01	1.33E+01	5.43E+01	**4**	1	0.4	0.02	0.004
Tier 1 95th UCL	1.29E-01	6.00E-02	1.88E-01	5.90E-01	1.33E+01	5.43E+01	**2**	0.7	0.2	0.01	0.002
Tier 2 95th UTL	1.15E-01	6.00E-02	1.88E-01	5.90E-01	1.33E+01	5.43E+01	**2**	0.6	0.2	0.01	0.002
Tier 2 95th UCL	8.48E-02	6.00E-02	1.88E-01	5.90E-01	1.33E+01	5.43E+01	1	0.5	0.1	0.01	0.002

Table A4.1.3
Non-PMJM Intake Estimates for Lead - Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -1.328 + 0.561 (ln Cs)	lnCi = -.218 + 0.807 (ln Cs)	lnCsm = 0.0761 + 0.4422 (ln Cs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
62.8	Tier 1 95th UTL	2.70	22.71	6.73	0.037	
42.7	Tier 1 95th UCL	2.18	16.64	5.68	0.022	
40.42	Tier 2 95th UTL	2.11	15.92	5.54	0.037	
36.59	Tier 2 95th UCL	2.00	14.69	5.30	0.022	
Intake Parameters						
	IR(food) (kg/kg BW day)	**IR(water) (kg/kg BW day)**	**IR(soil) (kg/kg BW day)**	**Pplant**	**Pinvert**	**Pmammal**
Mourning Dove - Hervibore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Herbivore						
Tier 1 95th UTL	6.22E-01	N/A	N/A	1.34E+00	4.44E-03	1.97E+00
Tier 1 95th UCL	5.01E-01	N/A	N/A	9.13E-01	2.64E-03	1.42E+00
Tier 2 95th UTL	4.86E-01	N/A	N/A	8.65E-01	4.44E-03	1.35E+00
Tier 2 95th UCL	4.59E-01	N/A	N/A	7.83E-01	2.64E-03	1.24E+00
Mourning Dove - Insectivore						
Tier 1 95th UTL		5.22E+00	N/A	1.34E+00	4.44E-03	6.57E+00
Tier 1 95th UCL		3.83E+00	N/A	9.13E-01	2.64E-03	4.74E+00
Tier 2 95th UTL		3.66E+00	N/A	8.65E-01	4.44E-03	4.53E+00
Tier 2 95th UCL		3.38E+00	N/A	7.83E-01	2.64E-03	4.16E+00

N/A = Not applicable.

Table A4.1.4

Non-PMJM Hazard Quotients for Lead - Default Exposure Scenario

		TRV (mg/kg BW day)					Hazard Quotients				
	Total Intake (mg/kg BW day)	NOAEL	Threshold	LOAEL	Geometric Mean NOAEL	Geometric mean LOAEL	NOAEL	Threshold	LOAEL	Geometric Mean NOAEL	Geometric Mean LOAEL
Mourning Dove - Herbivore											
Tier 1 95th UTL	1.97E+00	1.63E+00	1.78E+00	1.94E+00	1.09E+01	5.38E+01	1	1	1	0.2	0.04
Tier 1 95th UCL	1.42E+00	1.63E+00	1.78E+00	1.94E+00	1.09E+01	5.38E+01	0.9	0.8	0.7	0.1	0.03
Tier 2 95th UTL	1.35E+00	1.63E+00	1.78E+00	1.94E+00	1.09E+01	5.38E+01	0.8	0.8	0.7	0.1	0.03
Tier 2 95th UCL	1.24E+00	1.63E+00	1.78E+00	1.94E+00	1.09E+01	5.38E+01	0.8	0.7	0.6	0.1	0.02
Mourning Dove - Insectivore											
Tier 1 95th UTL	6.57E+00	1.63E+00	1.78E+00	1.94E+00	1.09E+01	5.38E+01	**4**	**4**	**3**	0.6	0.1
Tier 1 95th UCL	4.74E+00	1.63E+00	1.78E+00	1.94E+00	1.09E+01	5.38E+01	**3**	**3**	**2**	0.4	0.1
Tier 2 95th UTL	4.53E+00	1.63E+00	1.78E+00	1.94E+00	1.09E+01	5.38E+01	**3**	**3**	**2**	0.4	0.1
Tier 2 95th UCL	4.16E+00	1.63E+00	1.78E+00	1.94E+00	1.09E+01	5.38E+01	**3**	**2**	**2**	0.4	0.1

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Chemical-Specific Uncertainty Analysis

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ACRONYMS AND ABBREVIATIONS

BAF	bioaccumulation factor
CRA	Comprehensive Risk Assessment
ECOPC	ecological contaminants of potential concern
EcoSSL	ecological soil screening level
EPA	U.S. Environmental Protection Agency
EU	Exposure Unit
HQ	hazard quotient
IDEU	Inter-Drainage Exposure Unit
LOAEL	lowest observed adverse effect level
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
TRV	toxicity reference value
UCL	upper confidence limit
UTL	upper tolerance limit

1.0 INTRODUCTION

One potential limitation of the hazard quotient (HQ) approach is that calculated HQ values may sometimes be uncertain due to simplifications and assumptions in the underlying exposure and toxicity data used to derive the HQs. Where possible, this risk assessment provides information on three potential sources of uncertainty, described below.

- **Bioaccumulation Factors (BAFs).** For wildlife receptors, concentrations of contaminants in dietary items were estimated from surface soil using uptake equations. When the uptake equation was based on a simple linear model (e.g., Ctissue = BAF * Csoil), the default exposure scenario used a high-end estimate of the BAF (the 90th percentile BAF). However, the use of high-end BAFs may tend to overestimate tissue concentrations in some dietary items. In order to estimate more typical tissue concentrations, an alternate exposure scenario can be calculated using a 50th percentile (median) BAF to estimate total intake of an ECOPC. The use of the median BAF is consistent with the approach used in the U.S. Environmental Protection Agency (EPA) ecological soil screening level (EcoSSL) guidance (EPA 2005).
- **Toxicity Reference Values (TRVs).** The CRA Methodology utilized an established hierarchy to identify the most appropriate default TRVs for use in the ecological contaminant of potential concern (ECOPC) selection. However, in some instances, the default TRV selected may be overly conservative with regard to characterizing population-level risks. The determination of whether the default TRVs are thought to yield overly conservative estimates of risk is addressed in the uncertainty sections below on a chemical-by-chemical basis. When an alternate TRV is identified, the chemical-specific uncertainty sections provide a discussion of why the alternate TRV is thought to be appropriate to provide an alternative estimate of toxicity (e.g., endpoint relevance, species relevance, data quality, chemical form, etc.), and HQs can be calculated, where necessary using both default and alternate TRVs.

The influences of each of these uncertainties on the calculated HQs are discussed for each ECOPC in the following subsections.

1.1 Antimony

There are several key uncertainties associated with the risk estimation that should be considered in the risk description for antimony.

Bioaccumulation Factors

There is considerable uncertainty associated with the soil-to-invertebrate BAF for antimony. No soil-to-invertebrate BAF was identified in the CRA Methodology and, therefore, a default value of 1 was used as the BAF. As a result, all intake calculations assume that antimony concentrations in terrestrial invertebrate tissues are equal to concentrations in surface soils. Because antimony is not typically a bioaccumulative

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compound, this assumption is likely to overestimate antimony concentrations and subsequent risk estimations to an unknown degree.

Toxicity Reference Values

For mammalian receptors such as the deer mouse, review of the toxicity data provided in EPA (2003) indicates that only one bounded lowest observed adverse effect level (LOAEL), used in the risk estimation as the default LOAEL TRV, is lower than the geometric mean of growth and reproduction no observed adverse effect level (NOAEL) TRVs. All other bounded LOAEL TRVs for growth, reproduction, and mortality are more than an order of magnitude greater than the NOAEL and LOAEL used as the default TRVs. The default NOAEL and LOAEL TRVs for antimony are based on a decrease in rat progeny weight, and the effect of a predicted decrease in birth weight on the mammalian receptors in the Inter-Drainage Exposure Unit (EU) (IDEU) is unknown. Given that the geometric mean NOAEL TRV is less than the next lowest, bounded LOAEL TRV and the uncertainty regarding whether the endpoint predicted by the default LOAEL TRV is predictive of population-level effects, the geometric mean NOAEL provides a useful comparison point versus the default NOAEL and LOAEL TRVs.

Background Risk Calculations

Antimony was not detected in background surface soils. Therefore, background risks were not calculated for antimony in Appendix A, Volume 2, Attachment 9 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report).

1.2 Lead

There are several key uncertainties associated with the risk estimation that should be considered in the risk description for lead.

Bioaccumulation Factors

For the soil-to-plant, soil-to-invertebrate, and soil-to-small mammal BAFs, regression equations were used to estimate tissue concentrations. Confidence placed in these values is high; however, uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. In cases without available measurements of tissue concentrations, regression-based models are generally the best available predictor of tissue concentrations. However, the regression-based BAFs may still overestimate or underestimate tissue concentrations of lead to an unknown degree.

Toxicity Reference Values

The NOAEL and LOAEL TRVs for birds were obtained from EPA (2003). The EPA document reviewed the available effects database for avian effects from lead. The NOAEL TRV represents a dose of lead at which no growth, developmental, reproductive, or mortality effects were noted. The NOAEL TRV represents a dose rate at which no change in chicken reproduction was noted. The LOAEL TRV represents a dose rate at which a decrease in Japanese quail reproduction was noted, and the effect of a predicted decrease in reproduction on the avian receptors in the IDEU is unknown. A threshold

TRV, representing an estimate of the point between the NOAEL and LOAEL TRVs where effects related to the LOAEL TRV may begin to occur, was not calculated because the threshold point is uncertain and is impossible to accurately estimate given the available data. The default TRVs are based on appropriate endpoints and are of sufficient quality for use in the risk characterization. Uncertainties in these TRVs are likely to be low; however, risks may still be overestimate or underestimated to an unknown degree using these TRVs.

Background Risks

Lead was detected in background surface soils at the Rocky Flats Environmental Technology Site (RFETS). Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the Comprehensive Risk Assessment (CRA). This provides information necessary to help gauge the predictive ability of the risk assessment models used in the CRA. Because risks are not typically expected at normal background concentrations, background risk assessment results that indicate potentially significant risks in uncontaminated soils that do not show concentrations above what would be normally expected in soils in the vicinity of RFETS may be indicative of exposure models and/or TRVs that may be overly conservative. In addition, risks calculated using background data provide additional information on the magnitude of potentially site-related risks that are above what might be expected at natural background concentrations.

Risks to the mourning dove (herbivore and insectivore) were calculated in Appendix A, Volume 2, Attachment 9 of the RI/FS Report using both the upper confidence limit (UCL) and upper tolerance limit (UTL) of background soils. No HQs greater than 1 were calculated for the mourning dove (herbivore) using the NOAEL or LOAEL TRVs. NOAEL and LOAEL HQs for the mourning dove (insectivore) were greater than 1 for all UCL and UTL exposure point concentrations (EPCs). NOAEL HQs ranged from 4 (UTL EPC) to 3 (UCL EPC), whereas LOAEL HQs ranged from 3 (UTL EPC) to 2 (UCL EPC). Attachment 3 of this document indicates that the background concentrations of lead in Colorado and bordering states range from 10 to 700 milligrams per kilogram (mg/kg). The site-specific background UTL is equal to 53.3 mg/kg and does not appear to be elevated above what would be expected in the vicinity of the site. These results should be considered in the description of site-related risks and in the final risk-based conclusions.

2.0 REFERENCES

EPA, 2003. Guidance for Developing Ecological Soil Screening Levels (EcoSSLs). OSWER 9285.7-55. Office of Solid Waste and Emergency Response. December.

EPA, 2005. Guidance for Developing Ecological Soil Screening Levels (EcoSSLs). Attachment 4-1 Update. Office of Solid Waste and Emergency Response. February.

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CRA Analytical Data Set